ANNUAL SUBSCRIPTION: UNITED STATES AND CANADA, $10.00; FOREIGN, $12.00 (£2 10s.)

Volume XXVI MARCH, 1918 Number 3

MAR 6 1918
UNIV. OF MICH.

Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

EDITORIAL STAFF

FOR AMERICA

William J. Mayo, M.D.

E. Wyllys Andrews, M.D. J. Clarence Webster, M.D.

L. L. McArthur, M.D. E. C. Dudley, M.D. Frederic A. Besley, M.D.

A. J. Ochsner, M.D. C. S. Bacon, M.D. Carl Beck, M.D.

Thomas J. Watkins, M.D. John L. Porter, M.D. William R. Cubbins, M.D.

FOR THE BRITISH EMPIRE

A. W. Mayo-Robson, C.V.O., D.Sc., F.R.C.S.

Sir Berkeley Moynihan, C.B., M.S., F.R.C.S. Thomas W. Eden, M.D., F.R.C.S.

Harold J. Stiles, M.B., F.R.C.S. (Edin.) Henry Jellett, M.D., F.R.C.P.I.

James Rutherford Morison, M.B., F.R.C.S.

Franklin H. Martin, M.D., Managing Editor

Allen B. Kanavel, M.D., Associate Editor

EDITORIAL AND BUSINESS OFFICES: 30 N. Michigan Ave., Chicago, Illinois, U. S. A.

PUBLISHERS FOR GREAT BRITAIN: Bailliere, Tindall & Cox, 8 Henrietta St., Covent Garden, London, W. C., England

Hirst's Obstetrics

Just Out
New (8th) Edition

This edition is virtually a new work. The revision was so heavy that the book had to be reset. All the new advances in the field of obstetrics are included, presenting the subject from the viewpoint of modern obstetrics. Among the most important and extensive additions are new methods of anesthesia, new operations for repair of injuries to the birth canal, new technic for cesarean section and for other obstetric operations. Many new illustrations have been added, the work now containing 715 illustrations, 38 of them in colors.

Octavo of 863 pages, with 715 illustrations, 38 in colors. By Barton Cooke Hirst, M.D., LL.D., Professor of Obstetrics, University of Pennsylvania. Cloth, $5.00 net.

SAUNDERS, *Publishers*

See Page 13

Entered as second-class matter May 22, 1913, at the postoffice at Chicago, Ill., under the Act of Congress, March 3, 1897.

Copyright, 1918, by The Surgical Publishing Company of Chicago.

Why Use Slow X-Ray Plates?

THE statement is frequently made that the Paragon X-Ray Plates made before the war cut off foreign gelatine supply were the finest ever used. After long experiment we have been able to duplicate the speed and quality, and now offer them for your best work.

Use Paragon X-Ray Plates for highest grade of work. They are not surpassed by *any*. Late runs show the famous old-time Paragon quality. War troubles have been overcome.

If a lower priced plate is wanted, our Universal Brand cannot be beat for the money. The new emulsion now used is very fast—30% richer than before—giving brilliant black and white effects.

Both brands are adapted for use with or without intensifying screen.

Fast plates conserve tubes. Bear that in mind when you consider prices on plates.

Send for Price List of dependable X-Ray Supplies.

BARIUM SULPHATE—high quality, low price. A feature with us, as we take the entire output of a factory specializing on this.

GEO. W. BRADY & CO., 756 S. WESTERN AVE., Chicago

Many Brilliant Operations Have Been Marred by Sepsis

A focal infection removed from the seat of operation may be pouring bacteria into the blood stream, ready to lodge at a point of lowered resistance such as a laceration, an incision, a suture, a blood clot, and there set up an infection in spite of all technical and aseptic care.

Many of the foremost American and foreign surgeons are protecting their patients against sepsis in surgery, gynecology and obstetrics by prophylactic immunization with bacterial vaccines.

A dose of an appropriate vaccine given before and after every operation will prevent many unpleasant complications.

WRITE FOR LITERATURE

G. H. SHERMAN, M.D., Detroit, Mich. *Manufacturer of Bacterial Vaccines*

Daily Users of Vaccine Use Sherman's

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXVI MARCH, 1918 NUMBER 3

THE TREATMENT OF FRACTURES OF THE EXTREMITIES BY MEANS OF SUSPENSION AND TRACTION

BY MAJOR JOSEPH A. BLAKE, M.R.C., AND LIEUTENANT KENNETH BULKLEY, M.R.C.

IN 1916 one of us[1] described a method of treatment for fractures of the extremities by means of suspension and traction and reported 193 fractures treated in this way. Since the publication of that paper, there have been so many additions and changes that it has seemed wise not only again to describe the method but also to give the broader principles of application and a somewhat detailed description of its use for various fractures of the extremities at different levels.

It is the object of this paper to describe in detail (1) the various parts of the apparatus and (2) the method by which each fracture, according to site, is treated.

The advantages of the method, previously described, need be but briefly reviewed. The improvement in the circulation of the limb as evidenced by the rapid diminution in swelling, the greater ease of dressing, the facility with which the fracture can be controlled, and the great comfort of the patient, all speak in its favor. It is our distinct impression that union takes place more rapidly, that spreading infection necessitating amputation takes place less frequently, and that the motion of contiguous joints is more free, than by the use of any method of treatment involving absolute fixation.

Unlike the simple fractures seen in civil practice, in which the mechanism of fracture and the lines of force are fairly constant and the resulting displacement therefore also relatively constant, the compound fractures of military surgery follow no regular displacement. This is due to the fact that the great majority of compound fractures by shell, the most common and important type seen, are associated either with more or less extensive loss of muscle tissue or attachment or with nerve injury resulting in paralytic muscle. The relative position of the two fragments is, therefore, inconstant, and it is invariably necessary to place the limb in such a position, and maintain it there, *or change it if necessary*, so that the lower fragment is brought into correct alignment with the upper. We believe that this can best be accomplished and the concurrent wound at the same time be best treated by combined suspension and traction. By this method, carefully controlled by bedside roentgenographs, the proper alignment can be maintained.

THE APPARATUS

The apparatus for suspension consists of two frames each fitted to an end of the bed, and connected above the bed by two or more parallel bars. Each frame consists of two uprights joined by two transverse bars, the lower placed at the upper level of the mattress and the upper just low enough so that the

[1] Blake. Arch. d. méd. et pharm. mil., Paris, 1916, lxvi, 289.

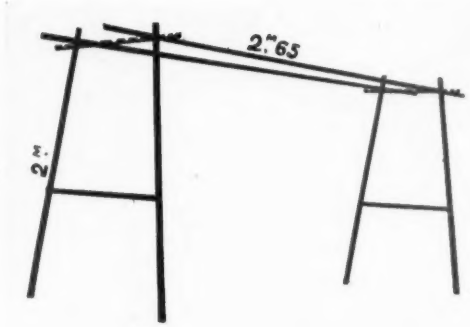


Fig. 1. Illustrates the general arrangement of the frame not placed on the bed. The longitudinal bars can be shifted laterally to any of the notches in the upper transverse bar shown more clearly in Figure 2.

uprights are not split by the holding screws. The upper transverse bar is notched to hold the longitudinal bar, each upper transverse bar having nine such notches. Each longitudinal bar has two notches at a distance from each other corresponding to the distance between the two end frames. The interlocking of the grooves prevents slipping and gives solidity. Figure 1 illustrates the construction of the frame.

The end frames (Fig. 2) have the form of a truncated cone, base downward, the distance between the feet being a little more, and the distance between the upper ends being a little less than the width of the bed. The width, therefore, is an inconstant factor depending on the bed used. The height is generally two meters. With pine, which has proved to be a very satisfactory wood, we have found that pieces 5 centimeters wide and 21 millimeters thick are sufficiently strong for the vertical and lower transverse bars, and pieces 6 centimeters wide for the upper transverse and longitudinal bars.

In order to allow the patient to change his longitudinal position, as for instance to sit up in bed, suspension must be movable. This is true only for fractures of the lower extremity. For those of the upper extremity it has seemed unnecessary. This range of motion is accomplished by the use of a trolley (Fig 3) consisting of a track and a movable piece of wood suspended from it. The track consists of a bar of iron, 10 millimeters thick and about 90 centimeters long, right angled at one end. The straight end passes through a hole in a small piece of iron bent to a right angle and screwed to one of the longitudinal bars. The angled end of the tract is fastened to the bar by a bandage. Suspended from this is a block of wood, about 40 centimeters long, in the upper edge of which are screwed two pulleys to run on the track, and on the lower edge of which are screwed three pulleys for suspension. Pulleys attached either by screws or hooks may be used. The latter seem more readily adjustable. The weights are commonly of 500 grams each. For more delicate adjustment, and especially where they are to be used suspended over the bed, small shot bags varying in weight from 250 to 1000 grams are employed. The approximate weights used are shown in the diagrams, but it must be remembered that they should be so adjusted as exactly to counterbalance the weight of

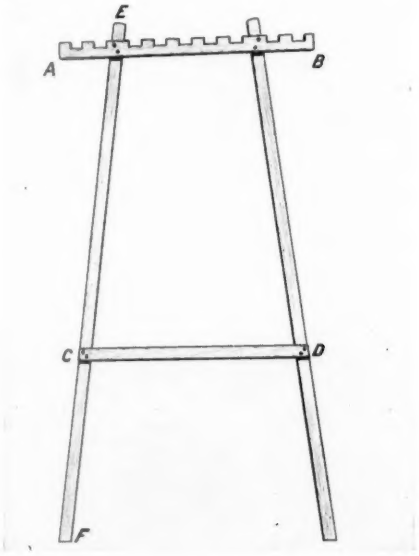


Fig. 2. To show the details of construction of each end frame. The center notch on the upper transverse bar is seldom used and tends to weaken the apparatus. It is better not cut. Each vertical measures 2 meters. The length of the transverse bars depends on the width of bed used. For the Service de Santé bed the upper bar measures 1 meter and the lower transverse bar 75 centimeters.

the limb. Due to the decrease of œdema, they frequently have to be reduced after the first or second day.

The limbs are suspended either by cloth bands or by metal splints to which cords are attached. The different forms will be described with the different fractures in which they are used.

For adhesive material we have used two different glues. (1) Heussner's glue (Colophane 50, 90 per cent alcohol 50, Venetian turpentine 1, benzine 10.) was formerly used in all cases and proved exceedingly satisfactory except for the occasional blistering which took place under it and for the necessity of shaving the part before application. After being applied to the shaved skin with a brush, the special extension bands of canton flannel (Fig 4) are laid on the extremity and bandaged in place. These bands are made in advance in two sizes, one for the leg and the other for the arm and sole of foot, and are provided at one end with a tape to fit the buckles of the apparatus. In using Heussner's glue, the skin should be prepared with soap and alcohol, but no antiseptic should be used. Absolute cleanliness and the removal of all grease is essential. More recently we have been employing the glue of Sinclair-Smith (2) (common glue 50, water 50, glycerine 2, thymol 1, calcium chloride 1). Its chief advantages are that the part does not require shaving before application and that it can be removed by the application of hot moist towels. It should be painted on the skin hot in a direction opposite to that in which traction is to be made. This avoids the discomfort of pulling hairs. Blistering seems to take place a little less frequently with this watery glue than with the varnish glue of Heussner, possibly due to the greater ease of evaporation. With either glue the bands will usually hold for ten days to three weeks before renewal becomes necessary.

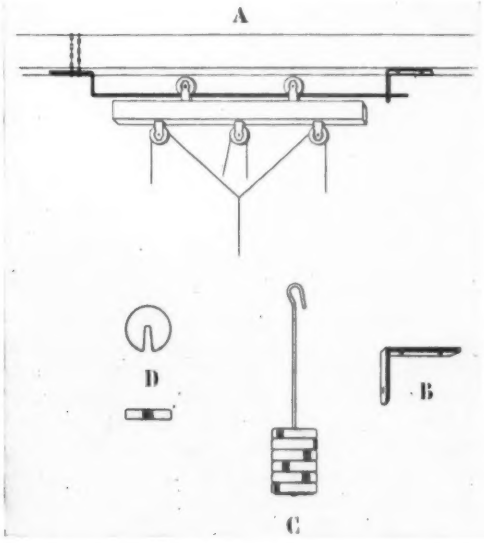


Fig. 3. To show the arrangement of the trolley. In *A* can be seen the iron bar serving as a track and right angled at one end while the other end passed through a small piece of iron (*B*) screwed to a longitudinal bar. The wooden block with 2 pulleys above and three below hangs from this bar. *C* and *D* show the lead weights used, each weighing a half kilo.

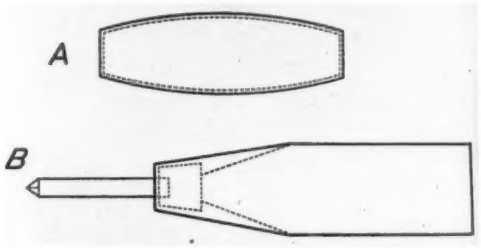


Fig. 4. *A* shows the shape of the bands used to support the limb in a Hodgen's or Blake splint or in a forearm cradle. They are made of 2 layers of unbleached muslin and in two sizes. The smaller measures 40 by 12 centimeters and the larger 60 by 20 centimeters. With wet dressings, bands of similar sizes but made of double faced rubberized linen can be used.

B shows the bands used with glue for traction. They are made of canton flannel in a small size for the forearm and the sole of the foot and a large size for the leg. They measure without the tape 25 by 8 centimeters and 40 by 15 centimeters respectively.

This action can usually be applied about twenty minutes after the bands have been glued in place. The details of the methods employed for fractures at various levels must be carefully studied for each individual case, as the lines of fracture and the injuries to soft parts with the resulting displacement of fragments vary so greatly. Constant supervision and revision of position and

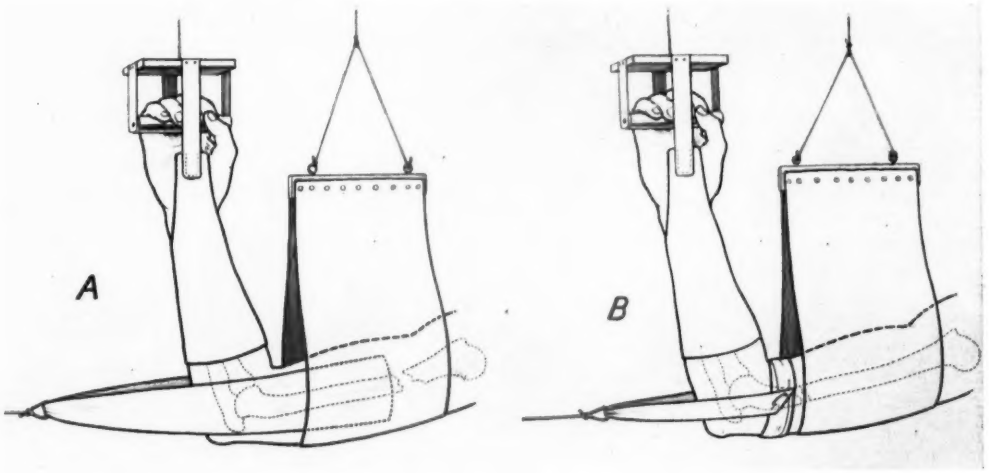


Fig. 5. Both figures illustrate the general method of suspension and extension in fractures of the humerus. *A* illustrates a high fracture in which traction by glued bands can be obtained. The drawing is incorrect in that no wooden spreader separates the bands. The arrangement of suspension of the forearm and direct suspension of the humerus are shown. *B* represents a lower fracture where glued bands cannot be employed. Here the Hennequin band is used. The spreader in this drawing is also lacking. It will be noted that the axis of the humeral shaft and the axis of traction are the same and that this is accomplished by the safety pin holding the band on each lateral aspect of the arm. The detail of the hand spreader can be better seen in Figure 8.

weights is necessary, for only in this way can the best results be obtained. It is essential that each apparatus be daily examined and the alignment of fragments clinically noted. If the slightest doubt as to position occurs, a bedside flouroscopic examination or roentgenograph should be made. As far as possible, we will attempt to indicate the treatment necessary for fractures of the extremities at various levels.

HUMERUS — GENERAL CONSIDERATIONS

The general arrangement of suspension and extension for fractures of the humerus is shown in Figures 5, 6, 7, and 8. Suspension is made at two points, direct suspension of the humerus itself and suspension of the forearm. The humerus is suspended by a single band of double-faced rubberized linen 20 centimeters wide and 70 centimeters long. The double bands originally described have now been practically discarded as unnecessary. The angulation they were designed to correct can be more easily controlled by traction, if used, and by the amount of suspension applied to the forearm. This single band passes under the arm and is attached at one end by thumb tacks to a block of wood. Its other end is pierced by eyelets which accurately fit small nails on the opposite side of the same block. In this way the band is not only prevented from becoming wrinkled, but it can be readily removed for dressings. To each end of this block is attached the extremity of a cord about 50 centimeters long, from the center of which is carried a second cord leading vertically upward from the center of the humerus to a pulley in a longitudinal bar. The relative amount of suspension obtained at the proximal and distal ends of the band can be controlled by shifting the point of attachment of the vertical cord to the cord attached to the block and anchoring this point of attachment with adhesive. In general, a kilo and a half suffices for the direct suspension of the humerus.

The forearm is suspended by means of two bands glued on the flexor and extensor surfaces (Fig. 8). They should not meet on the lateral aspects of the arm because of the constriction and interference with circulation which might follow. The tapes which are

Fig. 6. To illustrate the method of suspension in fracture of the humerus. It is to be noted that three longitudinal bars are employed, the outermost serving to support the forearm and maintain outward rotation of the lower fragment (see text under "Humerus, general considerations").

fastened to the ends of these bands are attached by buckles to a wooden spreader at the center of which is a hole for a knotted cord for suspension. The spreader for the hand should be a little longer than the width of the fist and three quarters as wide as its length. The straps of the suspension band pass over the side of the spreader, while to the ends of the spreader are fixed two elastic tapes attached to a round handle which can be adjusted so that the fingers can readily grasp it for exercise. This arrangement is of importance, especially in lesions of the musculospinal nerve. The suspension cord passes to a pulley on a longitudinal bar above the bed, this bar being placed 20 or more centimeters to the outer side of the bar by which the humerus is suspended (Fig. 6). In this way external rotation of the lower

Fig. 7. To illustrate a simple method of obtaining abduction and traction by means of a rough board slipped between mattress and bedspring and holding by friction (see text, "Humerus, upper third").

fragment is obtained, a result difficult to get if both humerus and forearm are suspended in the same longitudinal axis. The pulley suspending the forearm is usually placed sufficiently toward the foot of the bed to keep the elbow at an angle of about 135°. Later the angle may be decreased to 90° but the larger angle, if used early, assists in traction.

If traction is necessary, it can be obtained in one of two ways. Traction on the lower fragment by means of glued bands (Fig. 5) on each lateral aspect is very efficient. The spreader for traction of the arm should exceed the width of the elbow by 2 centimeters to avoid pressure on the humeral epicondyles. Traction is made from the spreader by means of a cord which passes over a pulley in a transverse bar attached at a suitable height to the frame at the foot of the bed. If the wound in the arm is in such a position that glued bands cannot be applied, traction can be obtained by means of a band passed about the lower humerus in much the same way as

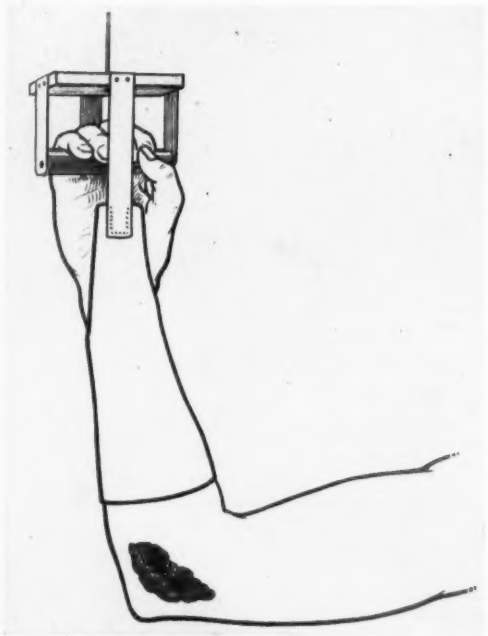


Fig. 8. Suspension of the forearm in a compound wound of the elbow-joint. The arrangement of the hand spreader (see text) and the lack of support of the upper arm are to be particularly noted.

in the method of Hennequin in fractures of the femur. This band is made of heavy muslin, about 6 centimeters in width and 1 meter in length. Its center is placed on the posterior surface of the lower arm, each end being brought forward and crossing to the opposite side where it is pinned in such a way that the traction, when applied, will be in the same axis as that of the humeral shaft (Fig. 5). In low wounds of the arm, a thick layer of cotton should be placed between the dressing and the band. Countertraction by the weight of the body is sufficient for fractures of the humerus.

In all fractures of the humerus treated by this method the patient should be encouraged to move the shoulder, elbow, wrist and fingers, and the hand and fingers should receive daily massage. The question of the amount of abduction will be considered with the detailed treatment of the fractures at different levels.

We will consider the modifications of the above outlined treatment as they apply to fractures at various levels of the humerus under three heads: (1) fractures of the upper third, including resections of the humeral head, (2) fractures of the middle third, and (3) fractures of the lower third, including resections of the elbow.

Humerus, upper third, including resections of the humeral head. Cases falling in this group should all be suspended as above outlined. Following humeral head resections, traction should not be used. The deltoid should not be stretched but rather allowed to crowd the divided shaft as closely as possible into the glenoid. Loss of function of the circumflex nerve or extensive loss of substance of the deltoid means a poor end-result following resection. The arm should be abducted nearly to a right angle in order that this position after healing can be assumed by the patient. Adduction can always be obtained by rotation of the scapula.

In high fractures of the surgical neck, the upper fragment is usually abducted and strongly rotated outward. The lower fragment must, therefore, be brought into this position. Figure 9 shows the arrangement of a patient with such a fracture. It will be noted that the frame at the head of the bed has been somewhat modified to meet the unusual requirements. The amount of traction in such a case must depend on the bedside roentgenographic findings.

In the fractures of the upper third of the shaft below the surgical neck, traction is usually necessary but need seldom amount to more than 2 kilos. It can usually be applied by means of glued bands. Suspension is carried out in the usual manner. The amount of abduction necessary will depend entirely on the amount of muscle injury. If the pectoral and latissimus attachments are lost, the abduction requirement will be greater than if these muscles were intact. Generally speaking, these fractures require about 60° abduction. A very simple method of obtaining this is shown in Figure 7. It consists in a rough unplaned board about 50 centimeters longer than the width of the bed and about 25 centimeters in width. This is

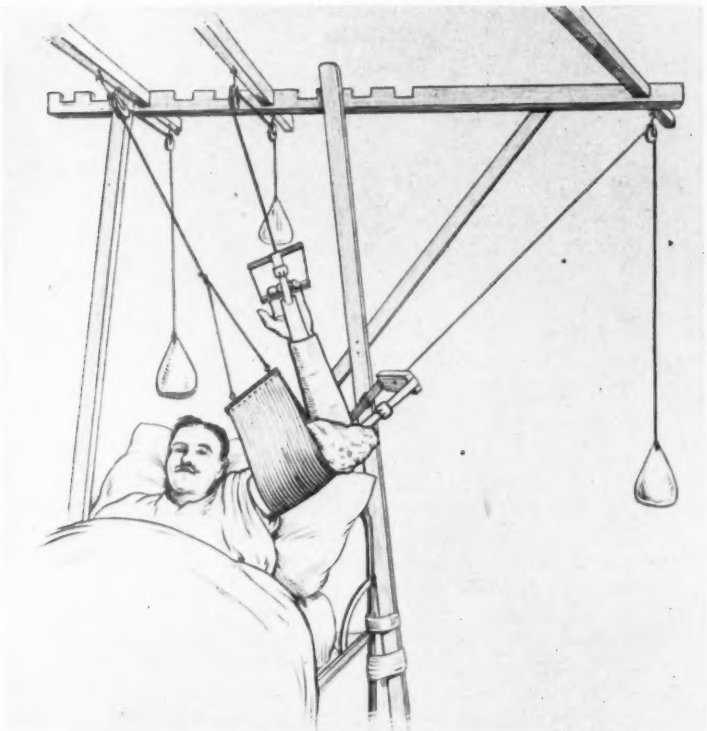


Fig. 9. Extreme abduction and external rotation in fracture of the surgical neck of the humerus. It will be noted that the frame at the head of the bed has been somewhat modified to meet the requirements (see text, "Humerus, upper third").

passed between the mattress and bedspring and is held in whatever position desired by friction and the weight of the patient. To its free end is attached an upright carrying a pulley. It can be placed in any position desired. It is essential that this board be rough and unpainted.

Humerus, middle third. Fractures of the middle third are suspended in the usual fashion but require careful attention to prevent anteroposterior bowing. Traction is usually made at an angle of abduction of about 45° and with a weight of about one and a half kilos. The concurrent wound is usually such that a Hennequin band must be used and it is in this group of fracture more than any other that the band must be pinned so as to pull exactly in the axis of the humeral shaft (Fig. 5, *A*, *B*). If the band is not pinned sufficiently low, anterior angulation will occur, and if pinned too far posteriorly, backward angulation takes place. The angulation is also controlled by the relative amount of weight used to support the forearm and the arm. Too much weight attached to the forearm results in posterior angulation, while too little allows a sagging of the elbow with resulting anterior angulation.

Humerus, lower third, including resections of the elbow. The higher fractures of the lower third are treated exactly as are those of the middle third. Care must be taken that the band supporting the humerus extends well below the site of fracture, as otherwise the elbow will sag and anterior angulation occur. Abduction need rarely exceed 25°. Traction of one kilo is usually sufficient.

After resections of the elbow, traction

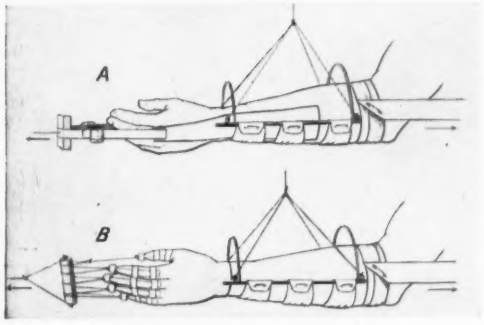


Fig. 10. The illustration shows the cradle used in fractures of the forearm, the bands supporting the forearm in the cradle, traction either by *X* glued bands (*A*) or by a glued glove (*B*). Countertraction by a Hennequin band is also shown.

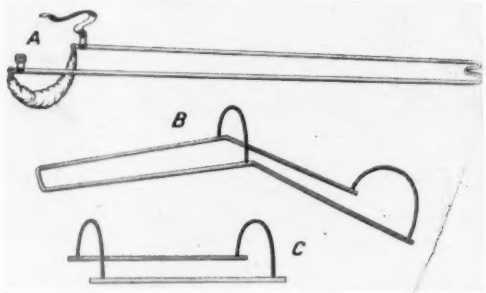


Fig. 11. Illustrates the three forms of metal splint used for suspension. *A* shows Lieut. Col. Keller's modification of the Thomas hip splint. For description see text. *B* shows Hodgen's splint. This is made in rights and lefts and is not interchangeable. The knee angle can be changed to suit the individual case.

C shows metal splint for suspension of the forearm. For description see text.

should never be used. The functional result obtained will depend largely on the operative procedure. If a careful subperiosteal resection, practiced by the Lyon School is done, early motion of the elbow should be encouraged with the view to re-formation of the joint. If the periosteum has not been preserved, the best that can be looked for is ankylosis but a flail joint will more often be the result. Suspension for this second type of case is useful only until the subsidence of the infection in the wound and should be replaced by absolute immobilization of the elbow in plaster as soon as possible. If ankylosis can be obtained, the angle of choice depends on the occupation of the patient. In a laboring man or farmer, about 135° gives the most useful arm.

In compound fractures of the elbow-joint without resection and in suppurative arthritis of the elbow-joint, suspension is most valuable but should be made only by the forearm (Fig. 8). The weight of the upper arm then tends to keep the ends of the bones separated and thus facilitate drainage.

FOREARM

The usual method of suspension and extension of the forearm is shown in Figure 10. The forearm is suspended in a sort of cradle (Fig. 11, c) which consists of two round iron bars, each 40 centimeters long and 8 or 9 millimeters thick, held together by 2 lighter curved iron bars riveted by their ends in holes in the parallel bars. The parallel bars are 15 centimeters distant from each other, but this distance can be increased by reducing the arc. These arcs pass above the forearm, which is suspended by double linen bands sewed to one another (Fig. 4, *A*). The narrow ends of the bands are passed over the sides of the parallel bars and fastened either with safety pins or metal clips, in such a way that they can be readily adjusted to support the part. When wet dressings or continuous irrigations are used, similar bands of double faced rubberized linen can be employed. If the wounds permit, extension can be made by bands glued to the lower forearm. In lower wounds very satisfactory traction can be obtained by means of a glove as shown in Figure 10. The hand is first thoroughly covered with glue, and then a white cotton glove, to the end of each finger of which has been attached a small metal ring, is drawn on. Traction is then made through the fingers, as much as a kilo and a half of weight being used. Great care must be taken that at least twice each day the traction is removed and both active and passive motion of all the small joints of the fingers practiced. Full supination is seldom necessary, a point a little short of this usually sufficing to prevent cross union.

In cases with considerable œdema, it is

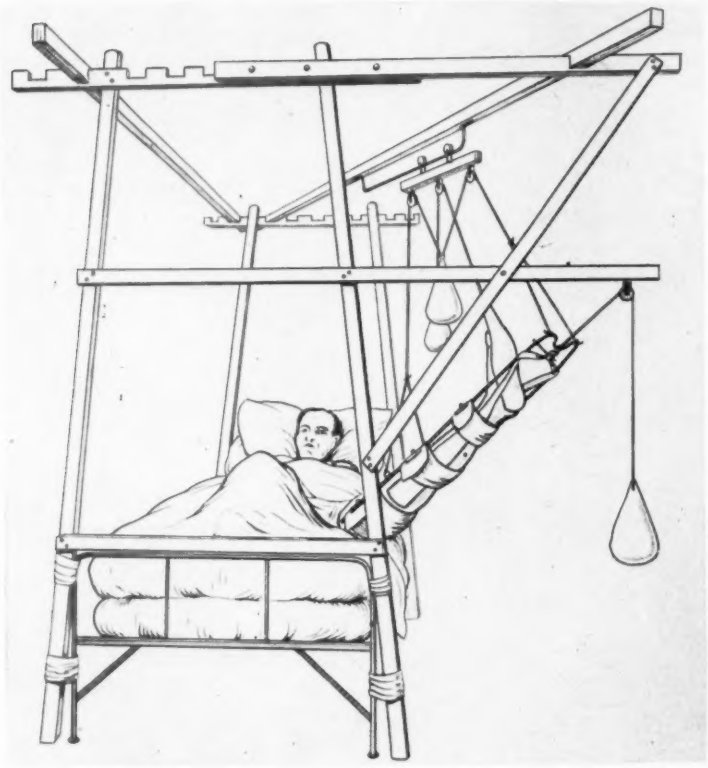


Fig. 12. To show the use of the straight splint and the method of obtaining traction. Note especially the building out of the foot of the frame, the wide abduction obtained, the angle of the supporting longitudinal bar closely corresponding to the angle of abduction of the leg, and the tourniquet method of obtaining traction within the splint. The method of preventing foot drop is also shown.

occasionally useful to suspend the forearm, either with band or a glove, in the vertical position. As soon as the condition of the wounds permits, the majority of fractures of the forearm, especially if one bone alone is involved, can be treated in molded plaster, as suspension offers no particular advantage.

FEMUR — GENERAL CONSIDERATIONS

In the treatment of compound fractures of the femur the ideal can frequently not be obtained by any apparatus, but with suspension and traction the results are more satisfactory than by absolute immobilization. The ideal position of flexion at the knee and hip, thus giving muscular relaxation, is often prevented by the fact that the position of the wounds interferes with the application of the traction. However, in the majority of cases satisfactory alignment with little or no overriding can be obtained, and the freedom of motion of the patient in bed prevents to a large extent the onset of pulmonary complications, probably the most common late cause of death following this type of injury.

All fractures of the femur, at whatever level are suspended. Figure 11, *A* and *B*, show the two types of splint employed. The application of each will be described under the separate fractures. The upper straight splint is a recent modification by Lieutenant Colonel W. L. Keller, United States Army, of the splint

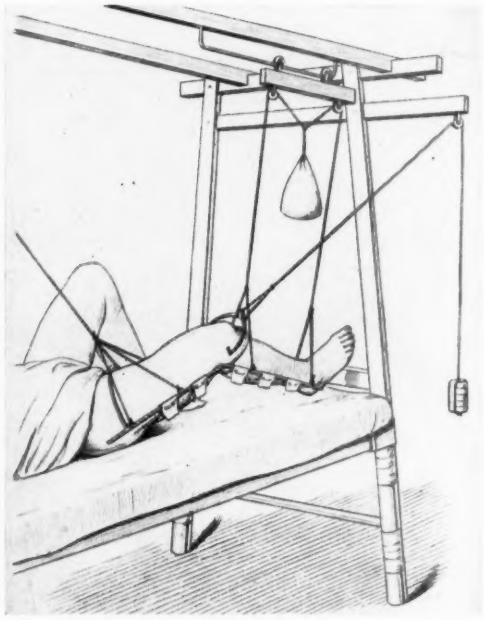


Fig. 13 Showing the arrangement for a fracture of the upper third of the femur. A Steinman nail has in this case been used. Note the flexion at the knee, the abduction and external rotation. The arrangement for the control of foot drop has not been figured (see text).

described in 1916 by one of us.[1] The loop for pressure against the pelvis has been hinged at its junction with the parallel bars, thus making the splint interchangeable for each leg. The distal ends of the bars are connected by a transverse portion which is bent proximally to form a median point for traction. The sliding metal stirrup has been removed. The method of obtaining traction is shown in Figure 12.

A stout bandage is attached to each traction tape, passed over the side of the parallel bars and over the end of the transverse distal portion of the splint. By means of a pin shorter than the width of the splint the two parts of the bandage are brought together and twisted, as is a tourniquet, thus shortening the distance between the sole and the end of the splint and obtaining traction. When sufficient lengthening has been obtained, the pin used for twisting is slipped slightly eccentrically and allowed to bear on one end of the splint, in this way maintaining the traction. Countertraction has in the meantime been obtained by the pressure of the upper end of the split on the pelvis, but as this is uncomfortable for the patient and apt to lead to bedsores if continued, it is relieved by traction on the entire frame by weights over the foot of the bed. This latter traction is, of course, omitted for purposes of transportation. The limb is suspended in this splint by means of the bands shown in Fig. 4, *A*. The splint itself is suspended by means of a trolley as shown in Figs. 3, 12, 13, and 14.

Figure 11, *B* shows the usual Hodgen's splint. The angle at the knee can be changed to suit the requirements of the case, as will be explained later. The drawing is self-explanatory and needs no further description. The cord supporting the upper portion of this splint passes to a pulley on the opposite longitudinal bar to that by which the limb is suspended in order to prevent the patient from sliding in bed and to prevent lateral inclination of the splint. The apparatus is usually better balanced if the distal suspension cords are attached one at about the level of the malleolus and the other at about the level of the knee. The weights used for suspension of either splint should exactly counterbalance the weight of the limb and must accordingly be varied for each case. As has already been mentioned in describing fractures of the upper extremity, each fracture should be roentgenographed in bed *after* clinical reduction is perfect. And the principle of invariably following the axis of the upper fragment with that of the lower must always be kept in mind.

Traction for fracture of the femur can be obtained in one of three ways: (1) by glued bands; (2) by direct bony skeletal traction, as by a Steinman pin or a Finochetto band; or (3) by pressure on the calf with a well-flexed Hodgen's splint.

Glued bands for fracture of the femur are usually unsatisfactory but must be occasionally used, especially with a straight splint. Much of the traction is lost, being transmitted to the pelvis by the skin and deep fascia. Consequently 10 to 15 kilos of weight are needed.

[1]Blake. Arch. d. méd. et d. phar. mil., Par., 1916, lxvi, 57.

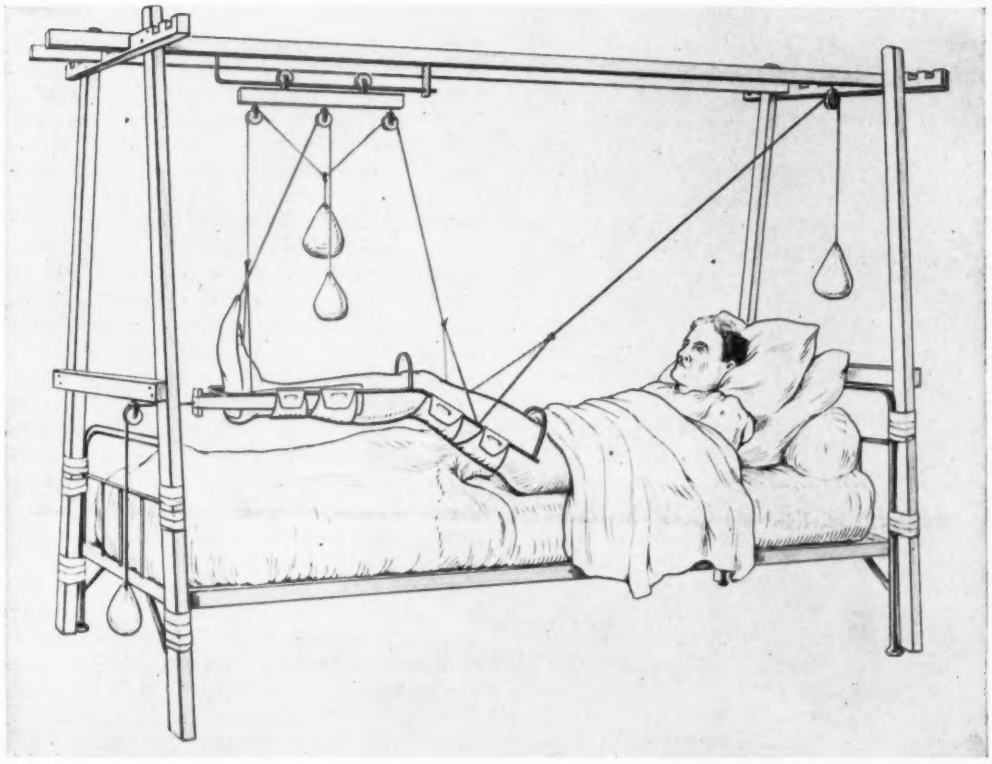


Fig. 14. Illustrates the method of suspension in fractures of the lower leg. The splint is bent to about 135°. The middle suspension cord is attached too far up the splint, which would balance better if this cord were attached nearer the knee (see text).

With skeletal traction, especially with a Steinman pin through the femur, about one-third of this weight is necessary. It is the ideal form of traction provided the question of infection can be eliminated. It is especially applicable in fractures of the upper half of the femur in connection with a well-bent Hodgen's splint.

In the third method of applying traction, the knee is flexed and the tractive force is applied against the back of the calf. This is ordinarily accomplished in one of two ways. In Hennequin's method, the limb, as high as the midthigh, is surrounded by a very thick dressing of non-absorbent cotton snugly bandaged in place. The knee must be kept in flexion while the dressing is applied and it is well to put a wet crinolin or very thin plaster-of-Paris bandage over all to keep he dressing in place. A figure-of-8 *hitch* is then made about the thigh and knee by means of a sheet folded several times so as to make a band a meter and a half long and 15 centimeters wide. This is probably the best method when the Steinman pin cannot be used for high fractures of the femur. It obviously can not be used in cases with low wounds of the thigh. The other method of calf traction is to bandage the leg to a well-bent Hodgen's splint and make the traction on the latter. This method affords access for dressing to wounds in the lower part of the thigh, but is scarcely applicable for initial traction because the pain and pressure on the calf are too great. Later when less traction is needed, it becomes a very serviceable method.

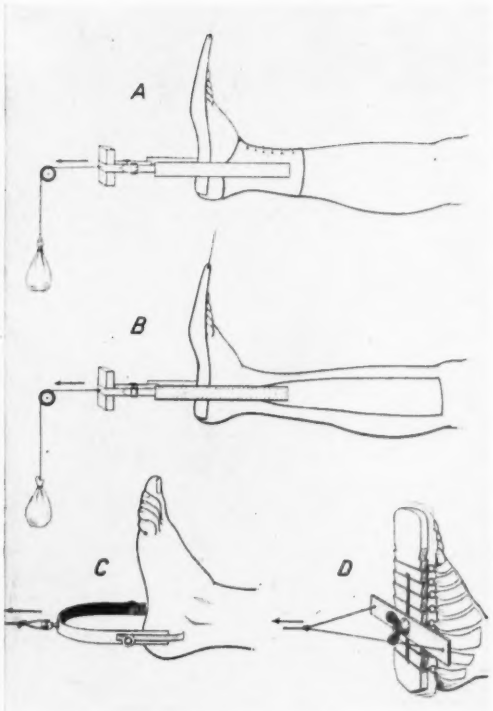


Fig. 15. To illustrate four methods of obtaining traction in fractures of the leg (for detailed description see text).

The arrangement which we use for preventing foot drop in all the cases of fractured femur and in some cases of fracture of the lower leg, depending on the form of traction used, deserves a word of explanation. A canton flannel traction band as used for the arm (see Fig. 4) is glued to the sole of the foot and extends a short distance beyond the toes. This band is attached to a cord which runs in a pulley attached to the trolley above the bed and has attached to it about a half kilo of weight. This maintains the length of the tendo Achilles and at the same time gives a movable support against which the patient can exercise the ankle. Rotation of the lower fragment can to a certain extent be controlled by changing the angle at which this band is glued to the sole of the foot (Figs. 12, 14, and 15).

Femur, upper third. In fractures of this portion of the femur the abductor and external rotator group of muscles are seldom destroyed and almost never loose their nerve supply. They accordingly continue to functionate, with resulting wide abduction and external rotation and some flexion of the upper fragment. For fractures at this level the Hodgen's splint shown in Fig. 11, *B* is generally used. Wide abduction together with considerable elevation and external rotation is the position of choice, this elevation helping to maintain countertraction by the weight of the patient's body. If there is a tendency for the patient to be pulled downward, additional countertraction can be obtained by moderate elevation of the foot of the bed. The amount of traction needed depends to a certain extent on the loss of bony and soft tissue, on the musculature of the patient, and on the length of time after injury when it is started. As a general rule, it is advisable to make strong traction during the first week, as greater lengthening with less weight can be obtained then than later. Ten kilos is usually sufficient, but the amount of weight used must be carefully controlled by accurate measurement and roentgenography.

External rotation of the lower fragment is obtained by elevating slightly by means of the suspension cords the inner side of the splint and by applying the band glued to the sole of the foot diagonally from the outer side of the heel well to the inner side of the great toe.

Figure 13 shows a patient with such a fracture. It will be noted that the frame at the foot of the bed has been modified by the addition of a longer transverse bar allowing abduction. In this case a Steinman pin has been used. If the situation of the wounds is such that the use of a pin appears dangerous because of possible infection, excellent traction can be obtained by the method of Hennequin, using a wide and well-flexed Hodgen's splint (see "Femur, general considerations"). If, for any reason either a Steinman nail or the Hennequin method cannot be used, the limb is put on a straightened Hodgen's splint, traction being made by bands glued well above the knee, with wide

abduction, external rotation, and flexion at the hip. Or a Finochetto stirrup can be employed. At least 12 kilos traction will be needed in order to stretch the hamstring and overcome the weight of the limb.

Femur, middle third. In these, the wounds are in the middle of the thigh and do not interfere materially with the use of any splint. But the method of Hennequin cannot be well employed. The position assumed by the upper fragment is in abduction if the fracture is above the adductor longus insertion; otherwise it is nearly straight. It is moderately flexed and rotated out.

The method of treatment depends on whether a Steinman pin can be used or not. If it can be used, the limb is put in a well-flexed Hodgen's splint with the knee and hip flexed, and is suspended in a position of moderate abduction and rotation outward. A traction weight of 4 to 5 kilos is to be used at the outset.

If the Steinman pin cannot be used on account of infection, extension straps or the stirrup are used with a straight Hodgen's or modified Thomas splint (the latter gives better lateral control of the fragments) and the limb suspended in a position of a slight abduction and flexion at the hip with rotation outward. A traction weight of 10 to 12 kilos is used at the outset.

Femur, lower third. These fractures are very difficult to treat on account of the position of the wound which often prevents the application of the proper method.

The position assumed by the upper fragment is practically in line with the body, the tendency to flexion being overcome by the sheath of the surrounding muscles. It rotates outward about 30°. The lower fragment, however, flexes at the knee, and in order to get it in line with the upper fragment, the knee must be flexed. The only efficient way in which to apply traction with this position of the knee is by means of the Steinman pin and this should be used in all clean cases. Treatment then is simple and the leg is put up as described for fractures of the middle of the shaft, with a weight of 3 to 4 kilos.

But in the majority of cases the Steinman pin cannot be used on account of infection, and then one is forced to use treatment bad in principle, namely, to put the limb up in a straight splint with extension straps or the stirrup for traction and wait until union is just beginning but the fracture line is still soft and pliable. The straight splint is then removed and a Hodgen's splint, angulated to about 110°, put on. When the limb is bent on this splint, flexion will not take place at the knee, which will have become stiffened, but at the fracture, and the fragments will be brought into line. To be successful, strong traction must be made up to the time of changing the splints, so that the muscles are actually overstretched and all overlapping overcome.

Fractures of the tibia and fibula. All wounds and fractures of the leg repair far more quickly if the limb is suspended, and this should always be done. The Hodgen's splint bent to an angle of 135° is employed, the usual arrangement being shown in Figure 14. The leg is suspended in the splint by the usual bands and the splint suspended above the bed by the trolley previously described. Countertraction is obtained by the portion of the splint supporting the thigh, care being taken that the upper suspension cord passes to the longitudinal bar on the opposite side of the bed.

Fractures of the fibula alone are of little consequence, being well supported by the tibia. They are suspended because of the improvement in circulation and for the dressing of wounds, but no traction is necessary.

Fractures of the tibia alone are splinted by the fibula and are prevented from overriding to any great extent, but incurvation is common. A slight traction of one to two kilos will correct this tendency.

Fractures of both bones demand more care. Here traction of three to four kilos is necessary.

Figure 15 illustrates the four methods of traction which have proved most satisfactory. They are more or less interchangeable, but each has its advantages.

Figure 15, *A*, illustrates traction by a gaiter made of two layers of unbleached muslin lacing across the instep and provided at each

side with a tape to fit the buckle of the spreader. The ankle should be well padded beneath the gaiter with cotton (not shown in the drawing for sake of clearness). It is necessary to use a glued band to the sole of the foot to prevent foot drop.

Figure 15, *B*, shows traction by bands glued to the side of the leg. Foot drop suspension is also necessary. A fair purchase can be obtained, if necessary, by very much shorter bands.

Figure 15, *C*, illustrates a Finochetto's band. This is very efficient and can be inserted with local anæsthesia. It should be used only where a clean local operative field can be obtained, for in the presence of infection the band cuts deeply into the os calcis. No suspension of the foot drop is necessary.

Figure 15, *D*, illustrates Sinclair-Smith's "skate," an exceedingly useful and ingenious device. It consists of a block of wood a little longer than the foot and very slightly wider, in the free edge of which are cut about ten notches. Its center contains a longitudinal slit through which passes a bolt provided with a thumb nut on the exposed side. The side of the board toward the foot is padded with cotton and covered with gauze. The transverse bar shown in the drawing is a piece of iron 5 millimeters thick, 2 centimeters wide, and 15 centimeters long, with a hole at the center and at each end. With glue 8 or 10 narrow tapes are pasted along each side of the foot, each tape having previously had attached at the end toward the sole a small curtain ring. The bands over the dorsum of the foot do not meet in the midline, but leave a free area to prevent constriction and interference with circulation. The foot is fastened to the board by lacing the rings on each side to each other on the under surface of the board. The apparatus forms practically a ball-and-socket joint for the control of the position of the foot. The lower free edge of the transverse metal bar rests on the parallel bars of the Hodgen's splint and maintains the position of the foot in the position in which it is placed. To elevate or depress the foot as a whole (correct anterior or posterior angulation at site of fracture), the wooden block is slipped upward or downward on the transverse bar, and the thumb screw tightened. To abduct or adduct the toes (rotate the lower fragment inward or outward), the block is rotated on the transverse bar and there fixed. To evert or invert the foot as a whole (correct lateral angulation at site of fracture), the cord leading from one extremity or the other of the transverse bar is shortened. The "skate" is especially useful in very low fractures of both bones and in fractures involving the ankle-joint.

FRACTURES OF THE TARSUS AND METATARSUS

These are commonly also treated by suspension, largely for the improvement in circulation obtained and the consequent more rapid healing. In those fractures involving the ankle-joint, traction by means of a Sinclair-Smith "skate" is used.

Traction otherwise is not indicated, but suspension to prevent foot drop should be used.

We wish to express our sincere appreciation of the careful translation of this paper by Dr. Pierre Payen, to whom we feel most indebted in his painstaking work.

SUTURELESS SKIN–SLIDING METHOD FOR THE RADICAL TREATMENT OF LUNG ABSCESS AND CHRONIC OSTEOMYELITIS

Specially Adapted to War Wounds[1]

By EMIL G. BECK, M.D., F.A.C.S., Chicago
Surgeon to the North Chicago Hospital

THE present war has produced a tremendous increase in the number of chronic suppurations. The hospitals of Europe are overcrowded with just such cases and no doubt before long we too will have thousands of these chronic suppurative cases to treat. It is, therefore, imperative and timely to discuss the treatment of chronic suppurations of bones and joints and the chest cavity.

I desire to bring before the profession some new suggestions for the treatment of this protracted type of suppuration. These suggestions are based on an experience gained in treating several thousand cases of chronic suppuration. Although most of the cases treated were not due to injury but originated from infectious diseases, the late conditions in both instances are so similar that I believe the treatment here outlined will be just as effective in war injuries.

Nearly all of the war wounds are infected from the very moment the missile penetrates the tissues. Infection is carried into the wound by fragments of clothing or the trench dirt, which usually covers the soldier's skin. It is fortunate that the field surgeons are now in a position to disinfect most of the wounds before the infection has spread and thus prevent many deaths, or the loathsome chronic pus discharge.

The methods of this immediate sterilization of wounds, such as were introduced by Carrel and others, and likewise the total excision of the infected wounds as practiced by English surgeons, need only to be mentioned here, since my remarks will be confined to the treatment of the late cases, those in which the prophylactic method had already been employed but in spite of which the chronic suppuration had persisted.

Guillot and Woimant[2] who recently published their experiences with infected fractures in the French base hospitals, state that probably 50 per cent of all fractures of the thigh still suppurate after ten months' treatment. Can any one of us realize what an amount of suffering this causes and what expense and labor is involved in dressing these wounds, aside from the economic loss caused by the incapacity of this vast number of men?

We shall divide the subject into two parts:

1. The treatment of chronic empyema and lung abscess after prolonged suppuration.
2. The treatment of chronic suppuration resulting from bone infection.

There is a vast amount of literature on both of these subjects. The evolution of methods of treatment varying from decade to decade, is well known to surgeons, but the fact that thousands of cases remain uncured indicates that we have not yet perfected our methods. We still encounter chronic suppurative empyema and lung abscesses, as well as sinuses from bones and joints, which have persisted for a quarter of a century, although they may have been operated upon repeatedly by most competent surgeons.

CHRONIC SUPPURATION OF THE LUNGS AND PLEURA

In order to arrive at a rational and consistent treatment, we must first ascertain in each case the etiology and pathology. The majority result from infectious disease of the lung or pleura, pneumonia and tuberculosis being the most common. Other diseases furnish a minor percentage. Injury to the lung caused by stab or gunshot wounds, or crushing, in peace times produce only a small percentage of cases, but now in war times the traumatic type predominates.

A foreign body penetrating the chest nearly always carries with it some infectious material and this produces a suppuration.

[2] Surg., Gynec. & Obst., 1917, xxv, 507.

[1] Read before the Western Surgical Association, St. Paul, 1916, and Omaha, 1917; and before the Chicago Surgical Society, January 5, 1918.
(See discussion, p. 362.)

J. P. Simonds,[1] who has made an extensive study of the gas bacillus infection, stated that the spores of the bacillus welchii were found in 100 per cent of the uniforms of Belgian soldiers who had come directly from the trenches, and also in the meshes of the samples of the new cloth from which the uniforms were made. Of twenty fresh war wounds, fifteen were found to contain this group of bacteria.

Even if the wound is sterile, the injury to the lung and the accumulation of blood furnishes a very favorable pabulum for subsequent infection and a consequent pyothorax.

At times a foreign body will remain in the lung for years without causing any symptoms and then give rise to the most distressing condition, "a lung abscess." The repeated puncture for a serous effusion, may change the sterile fluid into pus and thus produce an empyema.

The diagnosis of empyema is a rather simple matter. It must be differentiated principally from a serous effusion and from a lung abscess. A dullness of the chest, which changes with the position of the patient, corroborated by stereoroentgenograms, establishes the presence of fluid with unmistakable certainty. All that remains to be ascertained is whether this fluid is blood, pus, or serum. A puncture will decide the question.

Quite different and difficult is the diagnosis of lung abscess. A patient may be ill for weeks or months, carrying an abscess in his lung without its detection by the most painstaking search of the ablest diagnosticians. Even repeated puncture may fail to reveal its presence.

The cause of this difficulty is apparent when we consider that a lung abscess is usually much smaller in size than an empyema, is more centrally located, and is often surrounded by healthy lung tissue, or associated with a pneumothorax.

I regard a stereoroentgenogram of the entire chest as the most helpful aid in the diagnosis of lung abscess. We rely upon this one aid more than upon all the other diagnostic means except the history of the case. The stereoscope separates the different structures in the chest. The overlapping shadows, which in the single plate produce an indistinct and blurred picture, stand out in plastic effect, so that the lung abscess may be detected.

When a lung abscess has once ruptured into a bronchus, the diagnosis is as a rule mighty easy. In fact, we cannot escape it. It forces itself on one with the expiration of the patient's first breath when he begins to relate his complaint. Not all lung abscesses, however, have this characteristic foul odor. Some have no odor at all, but the patient will give the history of rupture of the abscess. He will relate how all at once he spat up a cupful of matter. Such cases, however, offer great difficulty in the localization, because the abscess sac is collapsed and never fills sufficiently to give a distinct shadow in the roentgenogram, or a sufficiently large area of dullness which can be outlined by percussion.

The diagnosis ascertained, the surgeon must decide what form of treatment to use. The accepted procedures are so well known that I shall not discuss them in this paper, except to make a few suggestions which may be helpful in preventing the formation of persistent drainage.

The empyema should be drained as low as possible and preferably posteriorly. Many cases persist in discharging because the tube has been inserted too high, and a recess formed by the dome of the diaphragm and the chest wall allows the retention of quantities of pus. When the drainage is low, the suppuration will usually cease within three or four weeks; occasionally it will persist for three or four months. A small residue, about one case in twenty, will keep on discharging indefinitely, especially a lung abscess which communicates with one or more bronchi. I have in my records of 110 consecutive cases of this last mentioned type of empyema and lung abscess, a case in which the sinus resulting from drainage persisted for thirty years.

When there is no tendency to spontaneous closure, the problem becomes a very difficult one. The patient usually resigns himself to his misfortune, dresses his chest wound once or twice a day, and is well enough to perform some light work. Whenever his health suffers, he becomes discouraged and is willing to take great risk; he will submit to any opera-

[1] Simonds, J. P. J. Exp. Med., 1917, June 1.

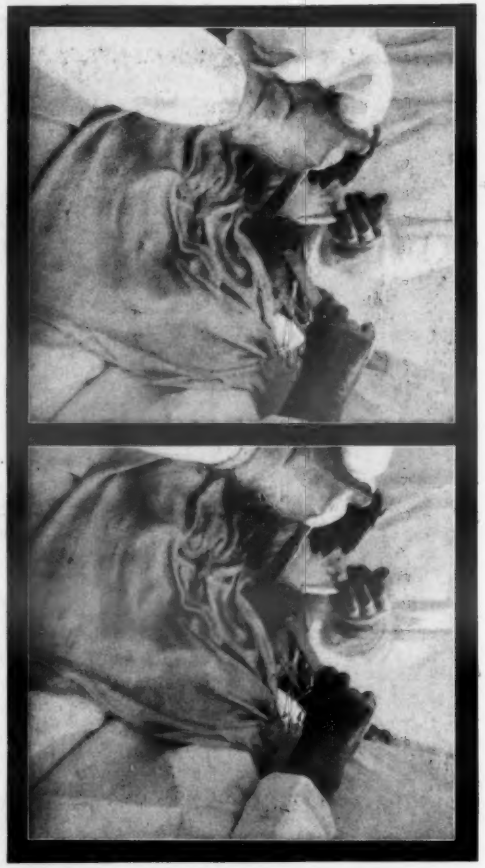


Plate III. Showing cauterization of the mucous lining of the bronchus, by means of Percy cautery.

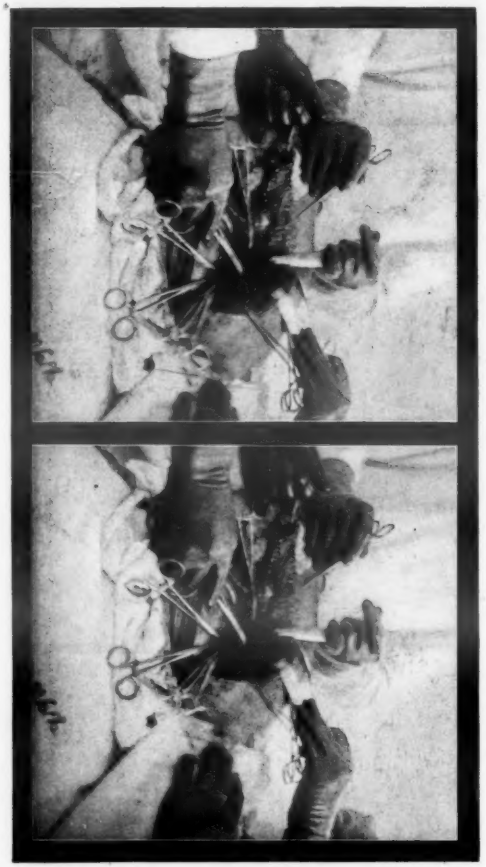


Plate II. Lung abscess exposed; skin flap being held outward, covered with warm salt sponge.

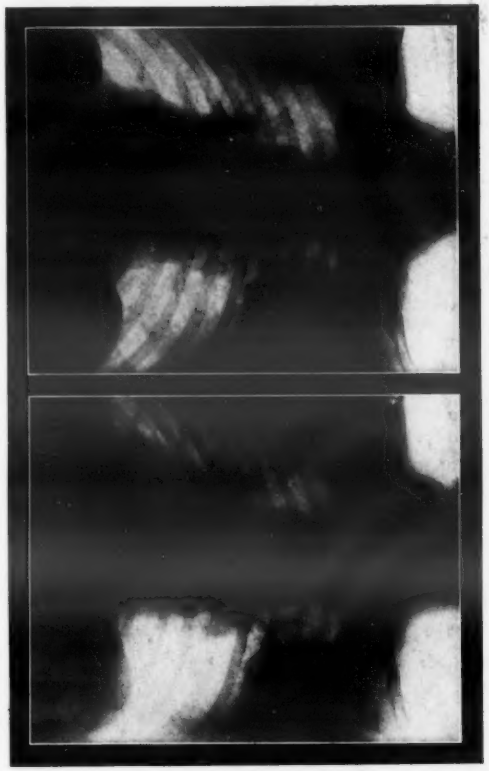


Plate I. Bismuth paste injected into lung abscess connecting with bronchi.

Plate VI. First operation. Implantation of skin flap into acetabulum. Trochanter exposed but not removed.

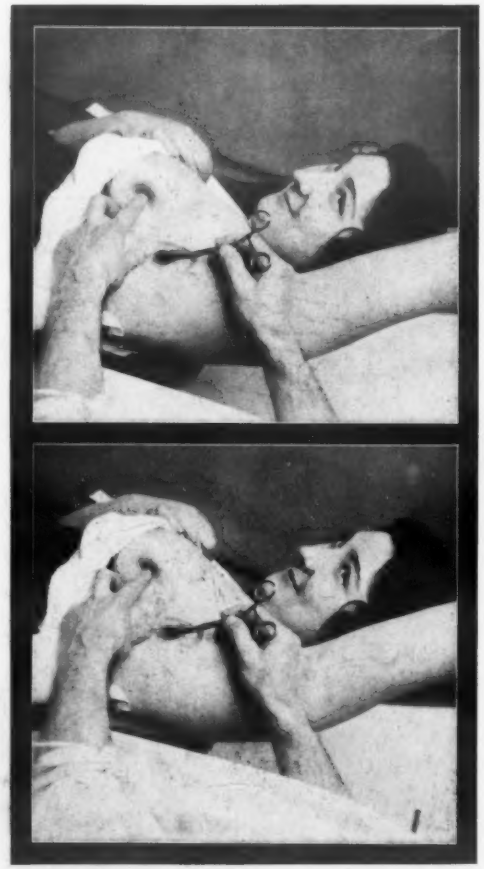


Plate V. Final result. Complete obliteration of abscess and opening into bronchus. Only short funnel, lined with skin, remaining.

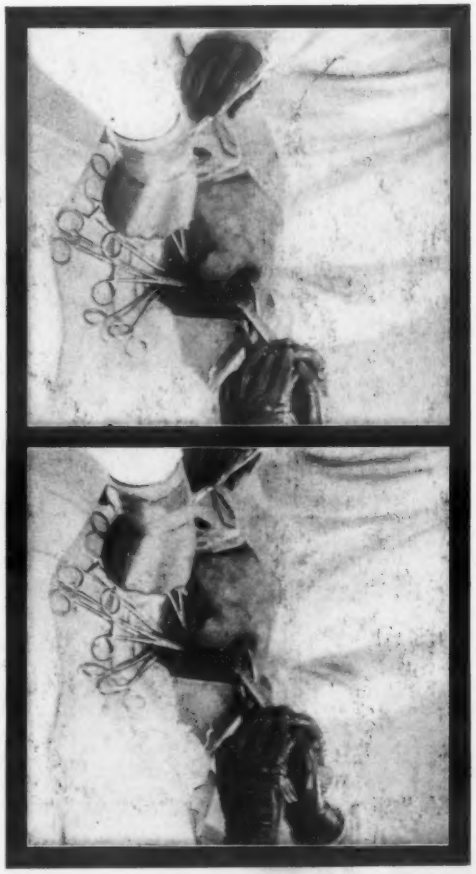


Plate IV. Implantation of skin flap into depth of the abscess cavity. Kept in place by gauze packing.

Plate IX. Three months later, after complete healing had taken place.

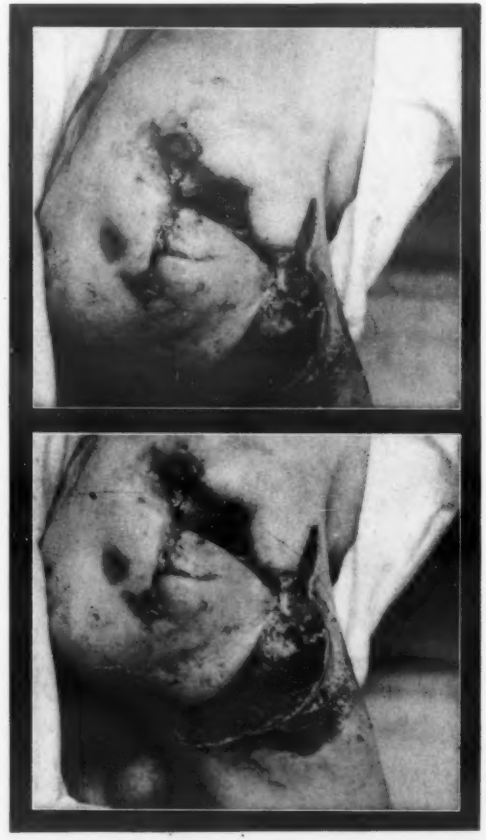


Plate VIII. Illustrates the condition two weeks after the operation showing large denuded surface of the thigh.

Plate VII. Second operation showing the technique of the implantation of a flap into the lower part of the cavity in the hip-joint, after the greater trochanter was removed.

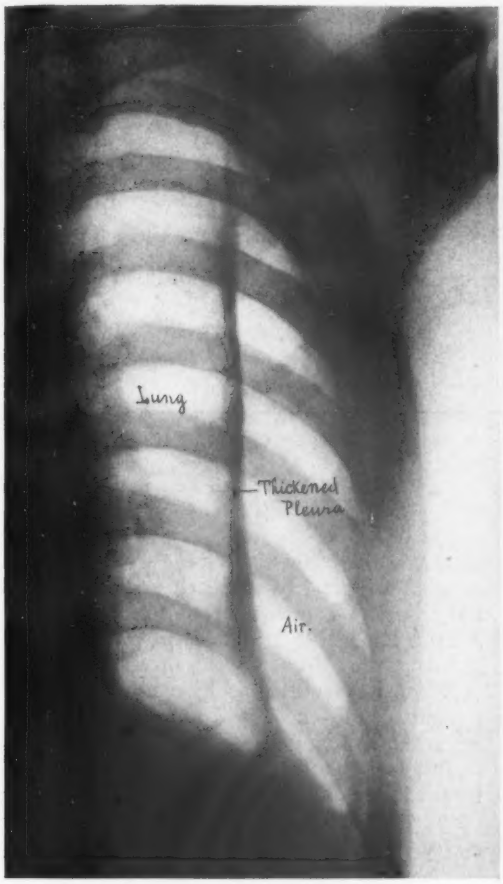


Fig. 1. Empyema showing thickened pleura dividing chest cavity; to the left the compressed lung, to the right the empyema cavity.

Fig. 2. Empyema (shown in Fig. 1) injected with bismuth paste. Note the thick pleura on margin of paste.

tion which will either cure him or commit him to his grave.

Ten years ago we introduced into surgery a new method of dealing with this class of cases; namely, the injection of bismuth paste. It is unnecessary here to repeat in detail the advantages and technique of this method. By this time the bismuth method is well known and the results from its employment and its dangers are all well defined. Let it be said that after ten years of trial, in almost all parts of the world, it has retained its place and is employed more extensively now than ever. The reports in the literature indicate that at least 4 out of 5 cases of the very old neglected suppurative empyemata or lung abscesses may be cured by this simple procedure. Ochsner, of Chicago, reported to the American Surgical Association on June 4, 1909, 14 cases of empyema, all of which had been operated on (two by Estlander's operation), with sinuses in all cases persisting nevertheless. He applied the bismuth paste in each of these cases, with the result that 12 cases healed completely and 2 were still under treatment at the time and very much im-

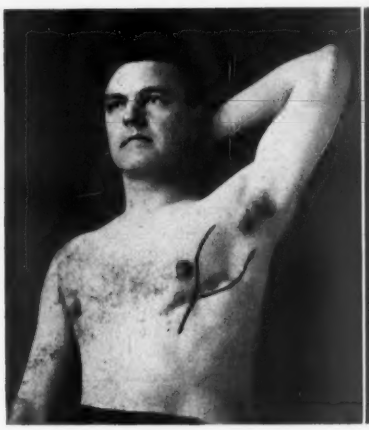


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Y-shaped incision for empyema, cavity high.
Fig. 4. X-shaped flap incision for very large cavities.
Fig. 5. "Trap-door" incision for lung abscess, when posterior.

proved. Others have reported equally good results. In my own series of 110 cases, approximately 80 per cent were cured by the bismuth injection treatment alone.

Omitting minor details it will be of benefit to mention some practical points in the technique:

Subsequent to a physical examination a stereoscopic roentgenogram of the entire chest (plate size 14x17) should be taken. This is a splendid guide to rational surgical treatment. The roentgenogram of an empyema or lung abscess resulting from tuberculosis of the lung will invariably give a characteristic picture; namely, a chronic or healed tuberculosis of the lung parenchyma, calcification of glands, and linear scar markings within the healed tuberculous lung tissue. A non-tuberculous case will show healthy, transparent lung tissue around the rather well-defined lung abscess.

After the pathological condition is ascertained and cultures taken, the cavity is injected with a 10 per cent bismuth-vaseline paste: bismuth subnitrate 10.0; vaseline 90.0.[1]

When the cavity or sinus is completely filled with this mixture, another set of stereoroentgenograms is taken. This set will illustrate the exact size of the cavity and its relation to the ribs and other structures in the chest. Whenever a communication with a bronchus exists, the patient will at once cough up the excess quantity of paste.

A word of caution is here necessary: the patient should be warned not to take a deep inspiration during the injection. He is apt to inhale (through the existing opening of a bronchus on the infected side) some of the mixture and force it into the bronchus of the opposite side.

The cavity may hold as much as 600 grams, but from 100 to 200 is the average. I here illustrate with Figure 1, which gives the definite outline of the cavity filled with air before the injection, showing the thickened pleura covering the contracted lung, thus dividing the left chest into two almost equal sections.

The second roentgenogram, Figure 2, shows the cavity entirely filled with bismuth, and plainly shows the inner boundary of the cavity to be formed by the thickened pleura. The sizes and shapes of these cavities vary so much that there are no two cases alike. Sometimes we find a small globular sac, communicating with the outer chest wall by a long tortuous channel, and then again we find that there exists merely a long sinus which communicates

[1]In former years I employed a mixture containing 30 per cent bismuth subnitrate but found that the above mixture produces equally good results and is not likely to cause bismuth absorption.

Fig. 6.

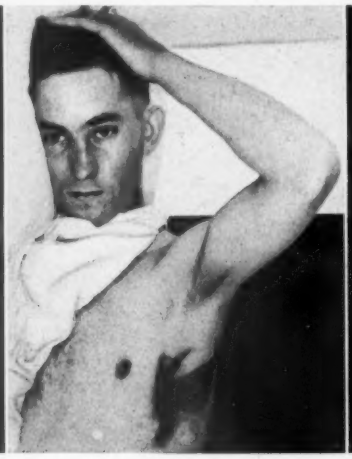


Fig. 7.

Fig. 8.

Fig. 6. Outlining the flap incision for empyema.
Fig. 7. Skin flap implant into empyema, 2 weeks after operation showing width of denuded surface.

Fig. 8. Patient 8 weeks after operation, showing denuded surface covered with skin, pus discharge ceased. Gain 20 pounds.

with a bronchus, without any cavity whatsoever. The stereoscopic effect permits us to estimate with considerable precision the depth of the cavity and its location (Plate I[1]).

As stated before, these bismuth injections are not only of great diagnostic but also therapeutic value. The first injection does not always produce healing. It requires at times repeated injections during several months, but whenever the discharge changes from pus to a serous character, the injections should be stopped because healing will usually follow. Only when the discharge continues to be purulent, should we consider more radical surgical procedure.

I have tried to ascertain why some cases respond to the bismuth treatment and why others do not, and I have come to the conclusion that whenever the cavity holds more than 200 grams it will be less likely to heal by bismuth injections. Cases which communicate with the bronchi are also more resistant than simple empyema.

Some cases will heal shortly after the injection and remain closed for a year or two and the patient be in good health, often gaining as much as thirty pounds, and then the sinus will reopen. The injections are then to be

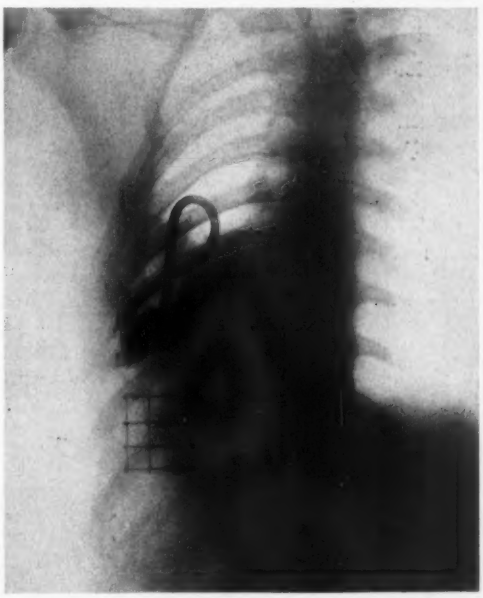


Fig. 9. Roentgenogram of empyema with rubber catheter, estimating the size of the cavity. Wire localizer estimates distance of abscess from the skin.

[1]The stereoscopic pictures accompanying this article may be viewed through the ordinary hand stereoscope, being specially printed with that purpose in view.

Fig. 10. Roentgenogram showing injected sinuses and illustrating the fallacy of probing the same.

repeated. Closure usually follows for another year or two, only to have another relapse after that period. The patient often prefers to keep on treatment in this way, not being much inconvenienced and perfectly well in the intervals.

But there remains a small number, about 1 in 5 cases, which have no tendency whatever to heal under any form of treatment, and these require the most radical surgical procedure.

The methods in vogue in dealing with these refractory cases are known as the Estlander, the Schede operation, or the decortication of the lung. The patient who has to submit to one of these extensive surgical procedures is, of course, in a desperate situation. He is told that the operation causes a high mortality and the surgeon cannot promise him an absolute cure even with this method. Aside from that, the surgeon must warn him of the prospect of a considerable deformity of his chest, whether he be cured or not. I have always hesitated to advise such extensive procedure and in the last seven years, I have not resorted to any of the above-mentioned operations.

SLIDING SKIN-FLAP OPERATION FOR LUNG ABSCESS

During the past seven years I have employed a surgical procedure in these cases which is far less dangerous and is, I believe, more effective than the Estlander or similar operations.

The patient is placed in a semirecumbent posture and anæsthetized. Before incising the skin a rubber catheter is introduced into the existing sinus and kept there as a guide during the first part of the operation. The skin incision differs in almost every case. It depends entirely upon the location of the abscess or empyema. I have devised and employed three different types of skin incisions, the Y shape, the X shape, and the trap-door incision. I illustrate here each of these incisions schematically (Figs. 3, 4, and 5).

It will be noted that each of these incisions forms one or more flaps of skin of various lengths, which are intended for implantation into the lung abscess after it has been exposed. The skin is not dissected from the underlying fat or muscle until we are ready to implant it into the abscess cavity.

From three to five ribs overlying the abscess cavity are now widely exposed and as many are resected as seems necessary to expose the lung abscess to its full extent. In cases of empyema even more than five ribs may have to be resected. One should not hesitate to remove as much rib length as seems feasible, four to seven inches of each if possible. In cases of empyema, where the cavity usually extends into the apex, we should endeavor to include the third rib in the resection if possible. This will facilitate the implantation of the skin flap into the very recess of the apex of the pleura, and prevent the granulation of this recess which occurs when the skin flap does not cover it completely.

The ribs removed, a small incision of the thickened pleura is made along the catheter, the finger is introduced into the abscess cavity and the cavity explored.

The incision of the pleura is extended up-

ward to the highest point, without cutting into the lung, and then the cavity is fully exposed to ocular inspection by removing as much of the parietal pleura as possible. This will usually make the opening into the abscess cavity large enough to introduce the entire hand.

In most cases of chronic empyema, the lung will be found retracted upward and inward. At times the apex will contain functionally normal lung. In the cases of lung abscess, however, the matter is different. The globular or multilocular cavity, with thick septa, exists, into which frequently open one or more bronchi. In one of my cases seven bronchi opened into one lung abscess. (Case shown at the Western Surgical Association in 1914.)

The cavity being fully exposed, it should be swabbed with dry gauze and the usually smooth surface of the abscess wall sufficiently scarified either by rubbing it roughly with gauze or even resorting to a mild curettage. This is done for the purpose of producing a favorable condition for the adhesion of the skin flap.

The cavity being dry, the tips of the skin flaps are drawn into the very deepest recesses by means of forceps. Gauze is packed tightly against them, to keep them in contact with the raw surfaces of the abscess cavity. No suture whatever is used.

The denuded surfaces from which the skin flaps are taken are then covered with sterile gauze, and no attempt is made to reduce the size.

At this stage the operation is completed, while in the Estlander, a great deal more work is necessary to complete it. The procedure should not last more than 100 minutes in the very extensive cases and can be done in 60 minutes in the less extensive ones. From a series of nine cases I cite only two for illustrations.

EMPYEMA PLEURÆ, WITH SINUS

The procedure just described was carried out on a young man, 26 years old, who retained a fistulous empyema subsequent to a pleuropneumonia six years ago. The case had the usual history of resection of one rib, rubber drain, with no tendency to cessation of the discharge:

Fig. 11. Three skin flaps implanted into tibia, 6 days after operation.

I first saw him four years ago (1913). His temperature rose daily to about 100°, his weight was 123 pounds. The empyema cavity would hold 22 ounces of the bismuth. Subsequent to the injections the cavity closed and he was in good health for about two years. Since then the abscess has reopened three times at intervals of 6 months.

The patient's health began to deteriorate and he returned in June, 1917, for the radical operation. The cavity was then discharging large quantities of pus, holding about one quart of fluid. A culture showed staphylococcus in pure culture.

The operation took place June 30, 1917. Although the work was done under favorable conditions, a film camera having been operated, causing frequent interruption, yet it look less than an hour to complete it. Four days later, the patient was able to walk around in the halls of the hospital. The cavity gradually diminished in size until at the present time it will not hold more than two Mayo sponges, whereas at the time of operation, I could introduce my entire hand into the cavity. Figures 6, 7, 8, and 9, illustrate some phases of the operation.

The technique will naturally vary a little in every case. Where bronchi communicate with the abscess cavity, the technique is

Fig. 12.

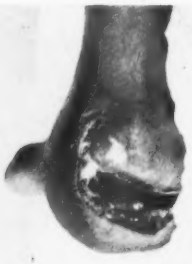


Fig. 13.

Fig. 14.

Fig. 12. Tuberculosis of os calcis. Discharging sinuses.
Fig. 13. Implanted skin flap into cavity left after removal of the os calcis.

Fig. 14. Complete closure of wound without suture, 5 weeks after operation. The foot has assumed nearly normal shape.

considerably changed. For this reason, I shall illustrate such a case, but mention only the principal difference in the technique.

LUNG ABSCESS WITH OPEN BRONCHUS

A girl of nineteen developed a lung abscess at the age of five, which was drained in the axillary line, in the region of the fifth rib. Constant discharge for fourteen years with expectoration of pus, in spite of all treatment, was the deciding factor for this extensive operation. A flap including skin, fascia, and muscle, eight inches in length, with the base toward the axilla and the apex pointing downward, was raised and the ribs exposed (Plate II). Two sections of the fourth and fifth ribs were removed. This laid open a small abscess cavity, so small as to be considered a portion of the bronchial fistula. The walls of the abscess cavity were smooth and glistening, and in this respect different from the epithelial lined bronchial opening.

The abscess cavity was explored with the finger. No foreign body was found, but on inspection the opening into a large bronchus was visible. The actual cautery was employed in this case to destroy the mucous membrane in the large bronchus, and thus insure complete obliteration of the opening. In order to prevent a fire, the ether anæsthesia was interrupted, and for about three minutes the patient was given oxygen by inhalation, to get rid of all the ether in the bronchi. The mucous membrane of the bronchial opening was destroyed by means of the Percy cautery (Plate III).

The steps in the implantation of the skin flap are practically the same as in the first case cited (Plate IV).

The further treatment of the case consisted in the adhesive plaster method of epidermization of the raw surfaces and daily dressings, until the entire cavity had been covered with epithelial growth. The discharge and cough stopped a few days after the operation and the patient gained 30 pounds in weight. The final result is shown in Plate V.

Fig. 15. Destruction of entire os calcis and two metatarsal bones.

If the abscess cavity remains widely open, the cauterization of the bronchus may be done subsequently at different sittings. The procedure is entirely painless and causes no other discomfort than the irritation produced by the smoke from the burning flesh, drawn into the trachea and nostril during inspiration.

The correct after-treatment in these cases is of the utmost importance. The gauze packing should not be removed for 48 hours. After this period the skin flaps will usually have become firmly adherent and the gauze

Fig. 16.

Fig. 17.

Fig. 18.

Fig. 16. Removal of diseased metatarsal bones. Tendons held back by gauze strips.

Fig. 17. Implantation of skin flap into ankle-joint. Compression by packing gauze against it.

Fig. 18. Photograph showing final result. Flexion and extension were nearly normal. The child is able to walk with but a slight limp.

packing can be safely removed without detaching them, although great care should be taken against such a mishap. A spatula should be pressed against the skin flap, while the gauze is being pulled out. No irrigation or medication is necessary, merely careful packing. This should be repeated daily and it will be noticed that the cavity is growing smaller from day to day and that the skin is gradually growing from the edges of the skin flaps, paving the cavity by degrees.

The most gratifying observation is the fact that the reduction of the size of the cavity is not due to filling of granulation tissue but rather to the expansion of the underlying lung, so that after a period of several months the skin flaps which were deep down in the cavity are now very much nearer the surface of the chest and only a shallow depression or a short funnel eventually remains.

The minor details and changes in procedure in individual cases must be left to the good judgment of the surgeon. He who attempts this class of work must have mature experience in general surgery. A novice had better not begin his career with such extensive operations.

CHRONIC SUPPURATIVE OSTEOMYELITIS (TRAUMATIC AND PATHOGENIC)

Aside from the vast number of cases of chronic bone and joint suppuration which result from diseases, such as tuberculosis, syphilis, and systemic pyogenic infection, we encounter many chronic suppurative bone lesions due to *external injuries*, such as compound fractures and gunshot wounds, also from bone plating and other operations. The traumatic types will, no doubt, be very prevalent after the present war. The progress made during the past three years in the treatment and especially in the prevention of suppuration after gunshot and shrapnel wounds, surpasses anything that has previously been done. Nevertheless, there is bound to be a vast residue of cases in which surgical procedures as well as the prophylactic measures have failed.

I shall illustrate by striking examples that some of these apparently incurable cases can be entirely healed by a method of operative treatment which I have employed with great satisfaction in 35 cases during the past five years. The method of procedure differs from the treatment of chest cases just described only in technique, the principle being

Fig. 19. Fig. 20. Fig. 21.

Fig. 19. Tuberculosis of foot, showing extent of diseases. All metatarsal bones destroyed.

Fig. 20. Result after excochleation of practically all metatarsal bones and part of os calcis.

Fig. 21. Showing final result after skin implant. Moderate extension and flexion. Three months after last operation. The patient can wear an ordinary stock shoe and walks without a crutch.

practically the same. The illustrations here presented will be more helpful in teaching the technique of this operative procedure than a verbal description.

The bismuth paste treatment should precede the operative treatment in every case, in order to save the patient an operation, if possible. I am pleased to say this is accomplished in more than 65 per cent of cases.

It is superfluous to mention again the technique in employing bismuth paste. It has been fully described in my previous publications.[1]

Guillot and Woimant [2] present a valuable contribution to the subject of early sterilization of the infected wounds and the late suppurations. They advocate first the Carrel-Dakin method of sterilization, usually followed by injections of different combinations of paste. They give preference to the bismuth paste, as they have observed no toxic effects and have obtained good results. They also advocate after sterilization of the wound, the implantation of fat and suture of the wound.

Those who have studied their report and observations and who will compare them with those contained in this article, will observe the essential difference to be as follows: They suture the wounds, while I do not. They use watery irrigation preceding the paste injection, while I omit all watery flushings. I believe the sutureless method to be preferable, since it does not lock up the paste mixtures, which after all are foreign substances and may lead to absorption and poisonous effects. The scars resulting from the sutureless method are not objectionable, as they are very inconspicuous.

We discarded the practice of flushing sinuses with watery solutions long ago, and have obtained very good results without them. It should, therefore, be established by those who are using flushings and the paste afterward whether the use of the paste alone will not accomplish as much.

As to the choice of the different pastes which are now being employed in practically all the war hospitals, I do not venture to dogmatize. I have now employed the bismuth-vaseline paste for ten years with very gratifying results and have found no reason to employ other new mixtures. This, however, does not preclude the possibility of an improvement, and I shall be pleased to adopt any other combination of paste as soon as I am convinced that it is superior to the bismuth.

The "b. i. p." mixture advocated by Rutherford Morrison of England is said to pro-

[1] Surg., Gynec. & Obst., 1917, xxv, 507.
[2] J. Am. M. Ass., 1916, lxvii, 21-27.

duce very favorable results. I used the combination of iodoform and bismuth when I first introduced the method about 10 years ago,[1] but on account of its odor, to which the patients objected, I had to discontinue it. I have found no difference in the results since its discontinuation. I would, however, warn against the closure of the wounds after the iodoform or bismuth mixture has been injected. Iodoform is even more toxic than bismuth. We have had our sad experience with bismuth intoxication which fortunately we are now able to avoid entirely.

It is, of course, essential that sequestra should not be allowed to remain in bone cavities, otherwise the bismuth treatment will not be effective. To ascertain the pressure of sequestra and foreign bodies, it is essential to take stereoscopic roentgenograms and submit them to a qualified roentgenologist. Upon his interpretation of the roentgenograms depends the decision as to whether an operation is indicated or not.

I consider the injection of bismuth for diagnostic purposes in these cases most essential and at the same time enter a protest against the use of the probe as a diagnostic instrument. The probe is very misleading when we wish to ascertain the depth of sinuses or bone cavities. One needs only to glance at one of these roentgenograms in which the sinuses have been injected, Figure 10, to convince himself that the use of the probe in ascertaining the course of the tract borders on the ridiculous. The tip of the probe may be resting in the nearest pocket or recess of the tract, and leave us under the impression that we have reached the bottom, whereas in fact there may be a network of sinuses into which the probe can never be introduced. In fact, the sinus at times may be twice as long as the probe itself.

Curettage of the bony cavities without ocular inspection is likewise inefficient, especially if it is done blindly by introducing the curette through the sinus opening and scraping in all directions. Such a procedure is mere guesswork. No one can know whether he has reached all the diseased areas. Many times I have convinced myself of this by

[1] See original article. J. Am. M. Ass., 1908, Mar. 14.

Fig. 22. Curettage without skin flap lower part of tibia. Eight years ago.

exposing the cavities which I had curetted and found that I had curetted in the directon of healthy bone and left the most diseased area untouched. Even exposure of the bone cavity and a very thorough curettage under ocular inspection does not always prevent the recurrence of the suppuration.

The customary procedure, for instance, of curetting the shaft of the femur, introducing a drain at one end and sewing the skin over the wound, will in most instances result in failure. A channel usually remains underneath the sutured skin and the suppuration soon returns.

The Mosetig-Moorhof plug, if properly introduced, may be of real service in such cases; but I shall describe a surgical procedure which I believe is more dependable.

SKIN-SLIDING OPERATION FOR OSTEOMYELITIS

After the diseased area is located by means of the roentgenograms, it is freely exposed by cutting away all the unhealthy skin and scar tissue. The diseased bone is then thoroughly curetted or chiseled away until one is certain that there is not a vestige left. Should this produce a deep groove, it must be converted into a very shallow one or even into a flat surface, by cutting away a sufficient quantity of healthy bone on either side.

After this is done, a skin flap is cut from one or each side, sufficiently large to cover almost the entire denuded bone surface, care being taken however, that no subcutaneous

Fig. 23.

Fig. 23. Large skin implant in head of tibia. Healing took place rapidly. Note denuded surface. Two years ago.

Fig. 24.

Fig. 24. Note healed head of tibia and new skin implants into middle of tibia.

Fig. 25.

Fig. 25. Final result.

fat is carried with it. The flaps are then shifted into the depth of the cavity and retained there by packing gauze against them. It is not absolutely necessary that every part of the bone cavity should be covered. The skin will grow from the edges of the flaps until every portion of the raw bone surface is covered with true skin. To prevent retraction or slipping of the skin flaps, I have frequently used a carpet tack to fasten temporarily the tip of the skin flap to the bone until adhesion has taken place. The areas of muscle and subcutaneous tissue which have been exposed by sliding the skin are left denuded. .No attempt should be made to bring their edges together by suture or otherwise. In only very rare instances has it been necessary to use any suture material whatever, except, of course, the ligation of bleeders.

Forty-eight hours later the gauze pack which has kept these flaps in apposition to the denuded bone surface is removed, and it will be found that firm adhesion has already taken place. In one case, in which an assistant displaced one of the flaps during the application of the dressing immediately after the operation, I was unable, twenty-four hours later, to replace the skin flap in its proper place, until I had loosened it with a raspatory. The rapidity with which adhesion of the skin to the bone takes place is remarkable (Figure 11, this case six days after operation).

The after-treatment is most interesting. As soon as granulations on the denuded surfaces from which the skin has been removed, begin to form, strips of adhesive plaster are applied, covering the margins of the skin border and the granulating surface all around the wound. This procedure will produce rapid epidermization of the denuded surface. The adhesive is changed daily. Within two or three weeks large areas will be covered by healthy skin and in practically every instance the suppuration will stop after the denuded area has been epidermized. Small scars, of course, remain but will gradually shrink, so that a denuded surface the breadth of three fingers will have a scar no wider than one-half centimeter.

When the wound is not too deep, the skin flap may be omitted. It is simply left widely gaping and packed with gauze and allowed to granulate from the bottom. Later on adhesive plaster is put on the edges of the wound.

I have employed this method of skin sliding in a variety of cases: osteomyelitis of the femur, tibia, in hip-joint disease, in knee-joint disease in the removal of the os calcis and of the metacarpal bones, in osteomyelitis of the ribs and of the sternum, and in other cases, including infected fractures and other injuries.

I shall now illustrate the efficiency of this procedure by some typical cases selected from my series.

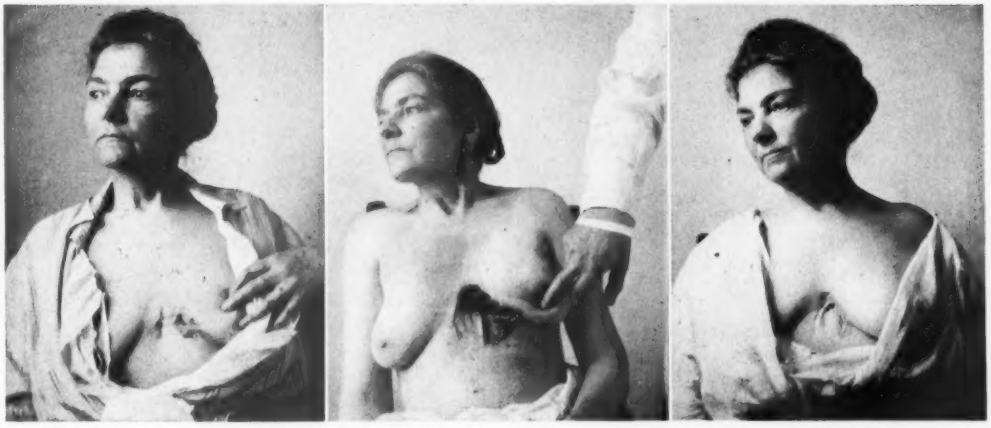


Fig. 26. Fig. 27. Fig. 28.

Fig. 26. Four sinuses from tuberculosis of sternum, discharging 15 years. After 5 operations.

Fig. 27. Skin flap implant after removal of sternum.

Fig. 28. Final results, 6 weeks later. The sinuses closed and the denuded surface was obliterated. The patient gained 20 pounds.

TUBERCULOSIS OF OS CALCIS — REMOVAL AND SKIN FLAP IMPLANT

Lillian P., colored, age 8. Stepped on a pin with right heel two years ago. The pin was extracted but a temperature of 104° followed, one foot became swollen, and an abscess resulted, which was drained. Suppuration continued and she remained in a hospital for six months. During her stay at the hospital, incisions into the heel were made at thirteen different times, then she was discharged as incurable. Ten months later, the left hip became swollen and painful. Tuberculosis of left hip was diagnosed. Rest in bed four months. While an abscess was prevented, the limb gradually became thinner and shorter. In September 1917, we find the right heel twice the normal size, with three profusely discharging sinuses (Fig. 12). Stereoscopic roentgenograms show destruction of the entire os calcis (Fig. 15). The left limb is three inches shorter than the right, the muscles atrophied. Stereoscopic roentgenograms disclose a healed tuberculosis of the hip-joint, the head being entirely absorbed and joint ankylosed. Diagnosis: Tuberculosis of right os calcis, associated with healed tuberculosis of the left hip.

Operation. A tongue-shaped flap with its base upward at the back of the heel was dissected. The tendo Achilles which was still firmly attached to some of the fragments of the os calcis was divided. This gave splendid access for the removal of the entire os calcis (Fig. 13). Instead of suturing, the flap was pushed into the cavity produced, and gauze packed against it. Within twenty-four hours the skin flap was adherent, and filled part of the large cavity. The defect grew smaller each day and finally healed completely and the foot assumed nearly normal shape (Fig. 14). The child is now able to walk since a pair of shoes has been provided for her. The right shoe has a padding in the heel to make up the deficiency. The left foot was provided with a regular 3-inch high sole shoe to overcome the shortening due to the hip disease.

TWO CASES OF TUBERCULOSIS OF THE ANKLE

Florence B., age 5, had tuberculosis of the right ankle, which progressed so rapidly in spite of all treatment in a well equipped hospital, that within two years from its inception, amputation of the foot was recommended. The child was unable to walk and profusely discharging sinuses persisted after several minor operations had been performed.

On March 15, 1917, I performed a radical operation by the skin-sliding method. Figure 16 illustrates the flap incision with exposure of the metatarsal bones, the tendons being held back by a gauze strip. The metatarsal bones were removed and the skin flap implanted (Fig. 17).

The final result of this case is shown in Fig. 18, the child being able to walk with only a perceptible limp and able to flex and extend the foot to almost the same degree as her healthy foot.

A vary similar case is that of boy 8 years old, in which the disease had destroyed practically all the metatarsal bones and the os calcis. The condition was so deplorable that nothing but an amputation seemed advisable (Fig. 19).

A complete excochleation of all the diseased bones was done by large openings on both sides of the foot, a suitable skin flap being provided in the incision on either side. These flaps were inserted deeply into the cavities. The final result is shown in Figs. 20 and 21, all the sinuses having closed, the boy being able to

Fig. 29 (at left). Showing skin implant into depth of dermoid cyst.

Fig. 30. Final result. Depression completely lined with skin. Suppuration ceased.

flex and extend the foot, to wear an ordinary stock shoe and to walk without a crutch (Figs. 20 and 21).

CHRONIC OSTEOMYELITIS OF THE TIBIA — TWO-STEP OPERATION

Miss I. C., age 26, when eight years, was kicked in the leg by a cow. Two years later, the leg suddenly became painful and swollen and within six weeks an abscess opened in the center of the tibia. Two months later, an operation was performed at home, but this failed to check the pus discharge, and from that time on, she has had repeated operations without any beneficial results.

In April 1909, I took stereoroentgenograms and found that the entire length of the tibia was involved in a chronic suppurative osteomyelitis. But the discharge being present only at the lower end of the tibia, Figure 22, I excised the skin overlying the diseased bone, chiseled off as much of it as possible, and allowed the cavity to granulate. The skin grew in from the sides and left a small scar.

In May, 1915, the patient returned on account of pain in the upper part of the tibia and high fever. At this time, I performed what I have described in this paper a skin-sliding operation, removing the diseased bone from the head of the tibia and sliding a flap of skin about 4 inches in length into its depth. Healing took place rapidly and the denuded surface of the tibia was covered with healthy skin within two months.

She remained perfectly well until August 1917, when she complained of pain in the middle of the tibia. A stereoroentgenogram proved that there was a sequestrum in the center of this bone, and another plastic skin-sliding operation was performed, using two skin flaps, one from each side to meet in the deep recess of the tibial canal. Figures 23, 24, and 25, illustrate the different phases of this procedure and the results. At the present time the entire limb is in perfect condition, no sinuses existing.

TUBERCULOSIS OF THE STERNUM

Miss D., dressmaker, age 40, has been suffering from disease of the sternum for 16 years. After five unsuccessful operations performed during this period, four profusely discharging sinuses remained (Fig. 26).

I saw her first in 1912, injected the sinuses with bismuth paste and suppuration ceased for about six months. Thereafter, I curetted the sinuses and injected them again, which produced a cessation of discharge for one year. From then on, the sinuses kept on suppurating and the condition grew worse. The patient lost in weight and she suffered a great deal of pain.

On January 20, 1917, I performed the skin-sliding operation, as illustrated in Figure 27, The skin covering the area involved was excised, the lower part of the sternum exposed and resected, and the deep bed from which it was removed curetted. A triangular flap of healthy skin was then cut from underneath the left breast and slid over into the depth of the cavity and kept there by compression of a gauze packing. The denuded surface of the breast was not sutured. Within six weeks the entire denuded surface was obliterated, partly by the contraction of the skin edges and partly by new growth of skin from all borders (Fig 28).

In this case we illustrate how the implanted skin flap, which at the time of operation reached into a deep funnel-like depression, has gradually risen toward the surface, so that at present it is almost level with the rest of the sternal surface. The patient's general condition has improved from the time of the operation, and she has gained some 20 pounds in weight.

Fig. 31.

Fig. 32.

Fig. 33.

Fig. 31. Flap incision for the exposure of the femur.
Fig. 32. Wide exposure of diseased femur. Skin flap covered with warm salt gauze.
Fig. 33. Complete eradication of disease, leaving no groove in the bone.

DERMOID CYST MISTAKEN FOR RECTAL FISTULA

G. M., age 60, was operated on ten years ago for what was then supposed to be a rectal fistula. The operation was very extensive having produced incontinence and later a stricture of the rectum. In 1914 the condition became very much aggravated, a very profuse discharge of pus from the rectum, pain and severe eczema around the anus, and gradual emaciation, compelled him to seek further treatment.

Intrarectal examination revealed a sinus opening in the posterior rectal wall, about two inches above the anus. The pus virtually poured from this sinus. The injection of bismuth paste into the cavity revealed a large area undermining the anterior aspect of the sacrum and coccyx. Diagnosis at this time: coccygeal tuberculosis with abscess formation. Operation: Instead of the longitudinal incision usually employed for the removal of the coccyx, I made a triangular flap with the apex pointing toward the anus. Raising the skin flap, I resected the fat and the coccyx and found underneath a fibrous structure resembling an indurated cyst wall. A urethral metal sound was then introduced through the rectal sinus and the wall of this sac pushed upward into the wound and incised. The skin flap was pushed into the depth of the wound to meet the opening just made into the sac.

Our diagnosis was then changed to dermoid cyst, the sac having contained a few long hairs. Figure 29 illustrates the condition a week after the operation, the skin flap having already healed in the depth of the wound, now about two inches deep. The pus now discharged through the external opening instead of the rectum. The bismuth injections were carried on through the external opening and within a short period the suppuration stopped, and both the intrarectal and extrarectal openings healed. The large wound contracted gradually and at present there is only a small depression in the region of the coccyx, as shown in Figure 30.

OSTEOMYELITIS OF FEMUR

Mr. B. The case here illustrated represents a type of chronic suppuration from the femur not very uncommon. The sinuses usually form near the ham-string tendons and the disease is most persistent, lasting indefinitely. Operations for this class of cases are particularly unsatisfactory. I have adopted a procedure entirely different from that heretofore employed.

The bismuth treatment had in this case been tried for six months without much effect. It was discovered that the shaft of the femur up to the middle of the thigh was filled with sequestra and pus. The knee-joint was also affected. The operation here illustrated was preliminary to a resection of the knee-joint, which was done later. Amputation was refused by the patient.

It is unnecessary to describe the steps of the operation, since the legends below the illustrations explain the technique as well as the underlying principles in the treatment (Figs. 31 to 36).

The disease in the femur is now entirely healed. Resection of the knee-joint as well as the operation on the tibia were performed later, the same principle having been carried out.

TUBERCULOSIS OF THE HIP, OF FIFTY YEARS' STANDING. OPERATION

Mr. D., age 54. Fell out of bed when about four years old and soon after developed tuberculosis of the hip, which resulted in the entire destruction of the hip-joint, which remained quiescent for about 35 years. The limb remained infantile and contracted at the age of 40, abscesses formed and many sinuses opening around the hip resulted. The condition improved spontaneously until three years ago, when he developed a severe pain in the hip and new abscesses began to develop. From this time on, conditions grew rapidly worse and he began to lose in weight and suppuration increased. He presented

Fig. 34.

Fig. 35.

Fig. 36.

Fig. 34. Skin flap inserted into depth and anchored with tack to bone. No suture.

Fig. 35. Wound 2 weeks after operation, showing gradual epidermization of denuded surfaces.

Fig. 36. Photograph taken 8 weeks after operation showing complete closure and epidermization. The disease in the femur is entirely healed.

himself in October, 1916, with four sinuses profusely discharging from the right hip, associated with severe tenderness, an œdematous and eczematous condition.

The stereoscopic roentgenogram shows a large network of sinuses surrounding the femur and the acetabulum. Injections of bismuth were continued and soon given up as futile, there being a number of sequestra in the hip, and the case was then considered incurable. Six months later, I reconsidered the matter and performed a radical skin-sliding operation. The hip-joint was exposed by cutting away all the diseased skin overlying it, the acetabulum was freed from all necrotic bone, the head having been destroyed previously. A healthy skin flap was denuded from the region of the buttocks and implanted into the depth of the cavity (Plate VI).

A month later another operation was performed as shown in Plate VII which illustrates the second step of the operation. This consisted of the resection of the greater trochanter and the implantation of another very large skin flap, to pave the lower part of the exposed hip-joint. This flap, about four by six inches in diameter, was denued from the lower part of the buttocks and implanted in the usual manner. Plate VIII illustrates the condition two weeks later, and Plate IX three months after complete healing had taken place.

The patient gained 20 pounds in weight, is in perfect health, but of course has an ankylosed short limb.

During the evolution of this skin-sliding method of treatment, I have from time to time presented some of the cases before medical associations and since then a number of my confrères have reported to me their satisfactory results in trying out this method. I therefore anticipate that now when the method has been perfected and when there is such an abundance of material in which it can be employed, its usefulness will be readily established.

SUMMARY

To sum up, I would advise the following procedures:

1. The methods of primary sterilization by means of aqueous flushings of wounds should be thoroughly tested to determine whether or not they are effective and practical without the additional use of pastes.

2. That the wide excision of tissues as now practiced in the war hospitals should be adhered to, as a means of preventing chronic suppuration.

3. That in cases in which early sterilization was not obtainable and the wounds persist in suppurating, the bismuth injection treatment or its similar substitutes should be employed, before any radical operation is resorted to.

4. That in the residue of cases in which the bismuth treatment is not effective, the sutureless method of skin sliding, as described in this paper, should be employed, since with this method we are able to clear up nearly all of these apparently hopeless cases.

GASTRIC FUNCTION FOLLOWING GASTRO-ENTEROSTOMY

An Analysis of 273 Cases[1]

By FRANK SMITHIES, M.D., F.A.C.P., Chicago
Associate Professor of Medicine, University of Illinois, College of Medicine; Gastro-Enterologist, Augustana Hospital; formerly Gastro-Enterologist at the Mayo Clinic

TO April 1, 1917, there had come under my observation 8,826 individuals affected with digestive disorders. Of this number, there were 273 patients, or 0.31 per cent, upon whom gastro-enterostomy had been performed for the relief of dyspepsia. These patients returned for re-examination of their own accord or upon request, in order that their digestive functions might be ascertained or they came because digestive upsets were troublesome. They represented 11.6 per cent of 2360 individuals upon whom operations had been done for diseases of the stomach or the duodenum. These diseases were gastric ulcer, 571 cases; duodenal ulcer, 1469 cases; and gastric cancer, 320 cases. It is not to be inferred that the remaining 88.4 per cent of patients in this group were well; no attempt has been made to trace them, inasmuch as this report is concerned with observations upon the functions of the gastro-enterostomized stomach, without particular effort being directed toward proving whether or no in the whole number of patients operated upon, the surgical procedure was the best type of therapy.

General observations. Of the 273 patients composing this series, there were 170 males and 103 females (Table I).

The *average age* at which gastro-enterostomy had been performed was for males 44.3 years and for females 41.5 years. When the patients returned for postoperative examination, the average age was for males 46.1 years and for females 44.3 years. It is thus evident that of the 273 cases, the males returned on an average of 1.8 years following operation and the females on an average of 2.8 years. The shortest interval intervening between operation and re-examination was, for males, 3 weeks, and for females, 11 weeks. The longest interval between operation and re-examination was for males, 9 years, and for females, 7 years. The above facts exclude 58 cases that were studied postoperatively before leaving the hospital, at an interval of from 3 to 6 weeks following laparotomy.

Primary operative procedures. As Table II demonstrates, posterior gastro-enterostomy, without or with pyloric closure or local or extensive gastric resection and combined with removal of the appendix or removal or drainage of the gall-bladder, was the operation of choice in 95.4 per cent of cases. In 4.24 per cent anterior gastro-enterostomy was similarly employed. In one patient, or 0.36 per cent, through faulty anatomical orientation, at another clinic, a gastro-ileostomy had been done under the impression that a gastro-enterostomy was being performed. This patient survived nearly one year.

Patients' subjective anomalies of digestion at re-examination. It should be again emphasized that 58 patients were examined within 6 weeks following operation. It is not to be expected that perfect digestive function had become established in so brief a time. However, reference to Table III shows that of 57 gastro-enterostomized patients (20.9 per cent of the series) clinically complaint free, there were 18 such whose operations had been very recent. Moreover, of 78 patients (28.9 per cent) who were subjectively in good health, but who experienced mild digestive upsets (usually stated as being "dietetic"), there were 26, or one-third of the group, whose laparotomies had taken place within 6 weeks. Of the entire series (273 cases), 104 patients (38.09 per cent) were definite dyspeptics, although they stated that operation had been followed by improvement. This class includes 9 patients (9.6 per cent) recently operated upon. There were 20 patients (6.9 per cent) in whom gastro-enterostomy has been followed by no improvement whatever in digestion and upon 3 of this class the operation had been performed less than 6 weeks previous to examination. Fourteen pa-

[1] Read at the twentieth annual meeting of the American Gastro-Enterological Association, Atlantic City, April 30 and May 1, 1917.

TABLE I.—SUMMARY OF MATERIAL STUDIED

Total cases examined	8826
Cases operated on in that time for gastric ulcer	571
Duodenal ulcer	1469
Cancer	320
Cases examined after gastro-enterostomy	273
Percentage	0.31
Ailment calling for primary operation	
Following operation for gastric or pyloric ulcer	226
Following operation for gastric cancer	12
Following operation for duodenal ulcer not involving pylorus	35
Sex	
Males	170
Females	103
Average age at operation	
Male	44.3 years
Females	41.5 years
Average age when re-examined	
Males	46.1 years
Females	44.3 years
Average length of time following gastro-enterostomy	
Males	1.8 years
Females	2.8 years
Longest interval	
Males	9.0 years
Females	7.0 years
Shortest interval	
Males	3.0 weeks
Females	11.0 weeks
Cases studied before leaving hospital, i.e., 3 to 6 weeks following operative procedure	58

tients (5.1 per cent) appeared to have experienced an aggravation of their dyspepsias postoperatively. Of the 2 patients recently operated on in this group, upon one had been performed simple posterior gastrojejunostomy without pyloric closure on account of non-stenosing pyloric ulcer and upon the other posterior gastrojejunostomy had been combined with resection of the pyloric fifth of the stomach for *ulcus carcinomatosum*.

It is evident from study of Table III that of the 273 gastro-enterostomized patients re-examined, but 20.9 per cent were complaint free; 49.8 per cent were clinically comfortable and in 87.89 per cent subjective benefit had accrued from the operation. If the 58 patients recently operated upon are deducted on the ground that it is as yet too early to establish their status, there still remain 196 patients (68.49 per cent) who have been subjectively improved by gastro-enterostomy and associated surgical procedures.

TABLE II.—OPERATIVE PROCEDURES

Type of Operation	Number of Cases	Per cent
Posterior gastrojejunostomy	91	33.3
Anterior gastrojejunostomy	5	1.8
* Posterior gastro-enterostomy with operative pyloric closure	50	18.3
Posterior gastro-enterostomy with resection of ulcer or part of stomach	26	9.5
Anterior gastro-enterostomy with resection of ulcer or part of stomach	3	1.09
Posterior gastro-enterostomy with appendicectomy	38	13.9
Posterior gastro-enterostomy with cholecystectomy	14	5.1
Posterior gastro-enterostomy with cholecystostomy	26	9.5
Posterior gastro-enterostomy with appendicectomy and cholecystectomy	8	2.9
Posterior gastro-enterostomy with appendicectomy and cholecystostomy	8	2.9
Anterior gastro-enterostomy and appendicectomy	2	0.73
Anterior gastro-enterostomy with cholecystostomy	1	0.36
Gastro-ileostomy with appendicectomy	1	0.36
Totals	273	99.74

* 17 cases of pyloric closure by suture or fascial bands.

Postoperative symptoms in patients not dyspepsia-free. There were 216 such patients. The type of their postoperative digestive upsets and their clinical symptoms are analyzed in detail in Table IV. It has seemed advisable to group the symptomatology according to the gastric or the duodenal ailment for which operation was performed. The summary makes apparent that where the surgery had been done for relief of cancer and of postpyloric duodenal ulcer, abdominal distress, anorexia, nausea, vomiting, gas, "waterbrash," and constipation, were more frequent than where the operative indication had been gastric or pyloric ulcer. Eructations of food and diarrhœa were rather more frequently observed in the gastric ulcer cases. It should be emphasized that very few gastric cancer patients returned for re-examination following operation. They were all in a bad way; what became of the original group (320 cases) of which they formed a part, it is not possible to state. Doubtless, fully half of the original group is dead. Weight loss had been experienced by nearly one-sixth of the gastric or pyloric ulcer class, by more than one-fourth of the duodenal group, and by all of the cancer patients.

TABLE III.—CLINICAL CONDITION OF PATIENTS

Status	Number of Patients	Per cent
Clinically complaint-free (includes 18 patients recently operated on)	57	20.9
Well — but with minor digestive upsets (includes 26 patients recently operated on)	78	28.9
Improved — but still dyspeptic (includes 9 patients recently operated on)	104	38.09
Not improved (includes 3 patients recently operated on)	20	6.9
Dyspepsia aggravated following operation (includes 2 patients recently operated on)	14	5.1
Total	273	99.89
SUMMARY		
Clinically comfortable	145	49.8
Improved	104	38.09
or		
Subjectively benefited (primarily)	249	87.89
Deducting 58 patients (23.8% of total) recently operated on leaves —		
Subjectively benefited (permanently)	191	69.9
Not improved	34	12.0

TABLE IV.—POSTOPERATIVE SYMPTOMS IN THE PATIENTS NOT DYSPEPSIA FREE

Complaint	Gastric or pyloric ulcer (226) No.	Per cent	Duodenal ulcer (35) No.	Per cent	Gastric cancer (12) No.	Per cent
Pain or distress	132	61.5	28	80	12	100.0
Anorexia	27	12.8	7	20	9	75.0
Nausea — constant or irregular	41	18.9	14	40	8	66.6
Vomiting	43	19.9	7	20	10	83.3
Stagnation type	20	9.2	4	11.4	6	50.0
Gas, bloat, etc	67	31.0	14	40	11	91.7
"Water brash"	34	15.7	8	22.8	5	41.6
Eructations	95	43.9	12	34.2	11	91.7
Constipation	44	20.3	8	22.8	9	75.0
Diarrhœa	19	8.9	3	8.5	2	16.6
Weight loss	35	16.2	10	28.5	12	100.0
Weakness	39	18.0	8	22.8	12	100.0
Nervous	18	8.2	4	11.4	5	41.6
Gross hæmorrhage	13	6.01	6	17.1	2	16.6

The incidence of gross hæmorrhage (hæmatemesis or melæna) following the operative procedures warrants consideration. It would apparently indicate delay in healing, recrudescence of the original ailment, malignant change or the occurrence of new pathologic processes (doubtless, most commonly ulcer). In more than 6 per cent of the gastric or pyloric ulcer cases, more than 17 per cent of the postpyloric duodenal ulcers and approximately 16.5 per cent of the gastric cancers, gross hæmorrhage had occurred postoperatively. In 6 patients, the hæmorrhages were exhibited within four weeks following the laparotomy. It is customary to ascribe such bleeding to faulty operative technique or to accidents. It is certainly not possible always to explain the event in this way. The occurrence of gastrorrhagia following surgical procedures upon the appendix, gall-bladder or pelvic organs, might indicate causes for such hæmorrhage, that are apart from those purely mechanical.

Signs of digestive mal-function (Table V). Less than one-third of the patients exhibited gross physical evidences of digestive anomaly. Of 68 patients whose blood was examined in but 30.8 per cent was the hæmoglobin below 80 per cent. There was nothing especially noteworthy in the blood-counts. Rather more than 10 per cent of the patients were definitely *cachectic*. This is not remarkable, when it is recalled that there were 12 cases of hopeless gastric cancer in the series. *Jaundice* was distinctly present in 11 cases (4.03 per cent). In 5 patients there was malignant disease involving the pancreas, gall-tract, or liver. In the remaining 6 cases, postoperative adhesions, perforated ulcer involving the pancreas, gall-stones, and biliary cirrhosis explained the jaundice. *Visible abdominal peristalsis* was observed in 19 patients (6.9 per cent). It seemingly resulted from gastric hypermotility associated with stenosis of either the pylorus or gastro-enterostomy stoma or both or occurred in the jejunum as a consequence of adhesions, or imperfect surgical maneuvers. In the patient upon whom gastro-ileostomy had been performed, distention and billowing of the abdomen were striking. Fæcal vomiting was a

TABLE V.—OBJECTIVE EVIDENCES OF DIGESTIVE MAL-FUNCTION

Sign	Number of cases	Per cent
Anæmia (Hg. 80 per cent or lower — of 68 cases examined)	21	30.8
Cachexia	28	10.3
Jaundice	11	4.03
Visible abdominal peristalsis	19	6.9
Abdominal tenderness	82	30.0
Abdominal ridge or mass	44	16.1
OBSERVATIONS UPON STOMACH SIZE		
Inflation method — 179 cases tested		
Stomach smaller	85 or 47.4 per cent	
Stomach larger	37 or 20.6 per cent	
No change	57 or 31.9 per cent	

daily event. *Abdominal tenderness* was recorded in 82 patients, or 30.0 per cent. It was constant in those patients examined soon after operation. In the patients whose gastro-enterostomies had been performed at intervals of 1 to 5 years, acute abdominal tenderness was noted rarely. Tenderness appeared to be commonly due to gastric hyperæsthesia (diffuse gastritis?), recurrence of ulcer, gastric cancer, gaseous distention of stomach or jejunal loop and in two instances to jejunal ulcer. *Abdominal ridge or mass* was observed in 44 cases, or 16.1 per cent. Of these there were 11 patients affected with gastric cancer. In the remaining cases the tumor was apparently produced by persistent abdominal-wall scar, adhesions of the viscera to the parietal peritoneum, local peritonitis about the operative field, exuberant scarring at the site of the gastro-enterostomy or the point of gastric resection, persistent ulcer scar, enlarged pancreas, inflamed lymph-nodes and rolled up omentum. In one case, a Murphy button had become partly detached and was fixed just beyond the gastrojejunal stoma.

Observations upon the size or capacity of the stomach were made by the air inflation method in 179 cases. It is recognized that such method is only relatively accurate. However, the air inflation is as reliable as are other accepted procedures. An air bulb of 1½ ounces (water capacity) was used. The average capacity of the normal male stomach was considered as 33 ounces and that of the normal female stomach as 27 ounces as demonstrated by me (1) from the examination of 7041 individuals in 1914. It will be observed (Table V) that in 47.4 per cent of the gastro-enterostomized patients the gastric capacity was below normal, in 20.6 per cent larger than normal, and in 31.9 per cent not appreciably changed. These facts are of value because it has been generally presumed that gastro-enterostomy brought about definite reduction in stomach size as a consequence of its "drainage" effect. Dietetic régimes have not often been based upon this supposition. It is, therefore, interesting to note that despite pyloric resection being associated with gastro-enterostomy in 10.59 per cent of our cases, less than one-half of the stomachs appear to be below normal capacity. The factor of rapid escape of air through the gastro-enterostomy stoma or through this and the pylorus, contributing to an apparent increased capacity of the stomach does not appear to warrant serious consideration. It is demonstrated by the fluoroscope and by testmeals that a sphincter-like arrangement commonly exists at the gastro-enterostomy stoma as well as at the pylorus and that air inflation tends rather to close the gastro-enterostomy stoma than to force it open: that is, provided the stomach is not greatly overinflated. Air inflation rarely results in dilatation of the jejunal loop.

TABLE VI.—TESTMEAL OBSERVATIONS

Gastric stagnation	
Longer than 8 hours after full meal	43 cases, or 16.4 per cent
Gastric hypersecretion	
More than 150 cc. recovered — exclusive of Group 1	29 cases, or 11.06 per cent
Average quantity removed	
Stagnation cases	347 cc.
Non-stagnation cases	126 cc.
Chymification	
	Per cent
Good	56.6
Fair	33.3
Poor	10.0
Bile stained gastric extracts	57.7
Discolored gastric extracts	11.8
Uncolored gastric extracts	30.5
Macroscopic blood	10.7

Test-meal observations (Table VI). The emptying rate of the gastro-enterostomized stomachs was estimated physiologically; i.e., the patient was permitted to eat a full mixed meal of foods that he liked, with the proviso that meat, lettuce (or celery or raisins) were included. The stomach was emptied after 8 hours by a large caliber stomach tube and afterward lavaged with 2 liters of warm water in order to avoid missing retention food bits. The observations of Levy and Kantor (2) upon 1600 patients and of ourself (1) upon 7041 patients have abundantly demonstrated that food must persistently remain for longer than 7 hours in order to establish proof that definite stagnation exists. Few stomachs are entirely food-free within 7 hours after a hearty meal of mixed food.

Of 262 patients in this series, whose stomach-emptying rate was examined, persistent *food stagnation*, as above defined, was

TABLE VII.—OBSERVATIONS UPON GASTRIC ACIDITY

FREE HYDROCHLORIC

No postoperative *reduction*	14 per cent
Postoperative *increase*	5 per cent
Reduction in	
Cases examined soon after operation *averaged*	35
Cases examined 1–3 yrs. after operation *averaged*	22
Cases examined 3–5 yrs. after operation *averaged*	14
Cases examined more than 5 yrs. after operation *averaged*	11
General average of acid reduction	20.5
In cases exhibiting "*vicious circle*" averaged	37

TOTAL ACIDITY

No postoperative *reduction*	17 per cent
Postoperative *increase*	3 per cent
Reduction in	
Cases examined soon after operation *averaged*	42
Cases examined 1–3 yrs. after operation *averaged*	13.5
Cases examined 3–5 yrs. after operation *averaged*	18
Cases examined more than 5 yrs. after operation *averaged*	10.6
General average of acid reduction	21.02
In cases exhibiting "*vicious circle*" averaged	28

TABLE VIII.—OTHER CHEMICAL TESTMEAL OBSERVATIONS

	Per cent	Cases Tested
Bile (Goodel's Test)	42	182
Altered blood (Benzidin test)	45.2	
Lactic acid (ether extract)	3.4	
Volatile fatty acids (heat test)	2	
Wolff-Junghan's test		
Positive	7.1	
Questionable	18	66
Negative	74.9	
Formol index (Sorensen-Schiff method)		81
Averaged	14.2	

demonstrated in 43, or 16.4 per cent. It was present in 10 of the 12 cancer cases in the series. *Gastric hypersecretion*, i.e., the recovery of more than 150 cubic centimeters of contents following an Ewald meal, was proved in 29 cases, or 11.06 per cent.

Of the entire series, the average quantity removed from the stomach was, for the stagnation cases, 347 cubic centimeters, and for the non-stagnation cases 126 cubic centimeters.

Chymification was "good" in 56.6 per cent, "fair" in 33.3 per cent, and "poor" in but 10 per cent. This observation is not without interest, in view of the criticism which is often made that gastro-enterostomy markedly alters gastric peristaltic activity, as demonstrated by the roentgen-ray. It is suggested that real food acts differently upon gastric mechanism than does an inert heavy mass of bismuth or barium.

Bile staining of the gastric extracts was definite in 57.7 per cent of meals examined. The colors ranged from a light golden yellow to grass green or olive. It is interesting to observe that even in high acid meals, bile-coloring was frequently intense; in fact, the macroscopic presence of bile coloring was no index of the degree of gastric acidity, either free hydrochloric acid or total.

Nearly one-third (30.5 per cent) of the gastric extracts were uncolored except as the shade varied with the test meal given. In 11.8 per cent of meals, discoloration resulted from food remains, cell detritus, bacterial or ferment action, and possible altered bile or blood.

Macroscopic blood was present in 10.7 per cent of the stomach contents. It was apparently of traumatic origin.

Observations upon gastric acidity. Inasmuch as numerous workers, particularly Bolton (3) and Paterson (4) have emphasized the importance of hydrochloric acid in the causation and the healing of peptic ulcer, comparison has been made between the test meal findings respecting acidity before and after gastro-enterostomy (Table VII).

It will be observed that there occurred no postoperative decrease in free hydrochloric acid in 14 per cent of cases and that in 5 per cent there was a definite increase. There was a *demonstrable reduction in free hydrochloric acid* in 81 per cent of all cases examined. This reduction averaged 20.5. The table also demonstrates that the reduction in free hydrochloric acid was greatest soon after operative procedures and that there was a steady diminution in the degree of acid reduction in direct proportion to the time interval following operation. The greatest average reduction —37—was recorded in those cases exhibiting "vicious circle."

Respecting *total acidity*, it is evident from Table VII that there occurred *no postoperative reduction* in 17 per cent and that there existed a *postoperative increase in 3 per cent.* In 80

per cent of the cases there was, however, definite *postoperative reduction in total acidity.* It averaged 21.02. The greatest degree of reduction occurred soon after laparotomy. In general, this degree became less pronounced as longer time intervened between operation and re-examination. Cases exhibiting "vicious circle" showed a total acidity reduction averaging 28.

The above facts clearly demonstrate persistent reduction in both free hydrochloric acid and total acidity following gastrojejunostomy. If excessive concentration of free hydrochloric acid is an important factor in the production of and the prevention of healing of peptic ulcer, then it might be assumed that gastrojejunostomy, properly used, holds valuable therapeutic possibilities. What effect upon the reduction of acidity and toward the healing of peptic ulcer, bile (noted macroscopically in 57.7 per cent of this series and chemically proved to be present by Goodel's test (5) in 42 per cent of 182 meals analyzed) exerts is open to question. Paterson (4), in a rather indefinite research, stoutly maintains that bile (mixed with pancreatic juice) is "present almost invariably, in the stomach after gastrojejunostomy." He states that the reduction in total acidity averages 30 per cent and that this is "partly due to neutralization of free hydrochloric acid by bile and pancreatic juice and partly to earlier stimulation of the pancreatic secretion and compensatory (!) earlier lessening of the gastric secretion." Paterson also states that after gastrojejunostomy there "is an almost constant increase in the mineral chlorides of the gastric contents" and as a rule "a diminution of the total chlorides." The "increase in the mineral chlorides disappears" after undoing a gastrojejunostomy. He claims that the average increase in the mineral chlorides is 0.077 per cent, and that such increase is evidently due to bile and pancreatic juice gaining access to the stomach through the anastomotic opening. It would seem that according to Paterson, this increase in mineral chlorides is an important factor in reducing gastric acidity and thus aiding ulcer healing. However, Panton and Tidy (6) maintain as the result of much painstaking research that there is no really reliable technique by which mineral salts (chlorides, phosphates) can be accurately estimated in gastric contents. They assert that in low acidity cases, the amount of phosphates present is probably independent of the clinical condition and that phosphates introduce a "fallacy" common to all methods investigated. Further that when free hydrochloric acid is low or absent, the "active hydrochloric acid" is overestimated because the fixed chlorides interact with phosphorus compounds, with the consequence that the phosphates are increased. Panton and Tidy also suggest that phosphates in excess are secreted into the gastric cavity, when the stomach mucosa fails to elaborate free hydrochloric acid from the mixture of phosphates and chlorides brought to it from the blood. It would thus appear that Paterson's opinion respecting the source of increased mineral chlorides in gastro-enterostomized stomachs is open to question and that even the increase which he maintains exists (0.077 per cent) is well within the possibility of chemical error. Hamburger (7) has recently confirmed the work of Schutz (8) and of Levites (9) with reference to the inhibiting action of various alkaline salts on peptic digestion. He claims that such alkalies definitely inhibit peptic digestion and, in a later communication with Halpern (10), suggests that inasmuch as phosphates, chlorides, and carbonates inactivate pepsin, a therapeutic advantage in the cure of peptic ulcer can be secured by their use. Inasmuch as it seems evident that phosphates (and perhaps chlorides) are increased in gastro-enterostomized stomachs as free hydrochloric acid is decreased, it would appear that the experiments of Hamburger and Halpern, might explain some of the beneficial effects of gastro-enterostomy toward ulcer cure. It is still unsettled whether bile and pancreatic juice contain "antipepsin" when regurgitated into the stomach. Bile was present in 9.5 per cent of the gastric contents from 140 non-stenosing ulcer cases that I analyzed (11)—and yet two-thirds of the ulcers lay in the pyloric fourth of the stomach where they could secure the maximum benefit of bile regurgitation should it contain "antipepsin."

Further chemical observations upon test-meals (Table VIII). As I have already mentioned *bile* was proved to be present in 42 per cent of the gastric extracts from 182 gastro-enterostomized stomachs.

Altered blood was demonstrated in 45.2 per cent; *lactic* acid in 3.4 per cent (mainly the cancer cases) and *volatile fatty acids* in 2 per cent (also the cancer cases).

Wolff-Junghans' test for soluble albumin was negative in nearly three-fourths of the cases.

The *formol index* demonstrated a slight increase over the ereptic power common to peptic ulcer, but no increase over that observed in cancer. It averaged 14.2 in 81 cases analyzed. Such increase might be taken to indicate the presence of pancreatic juice, although the rather high percentage (45.2) of extracts exhibiting blood positive altered blood test, may explain the increase.

Microscopic examination of gastric extracts exhibited nothing characteristic. In the benign stagnation extracts yeasts and sarcinæ were often abundant. In the malignant retention extracts organisms of the Oppler-Boas group were plentiful. Regurgitated bile and pancreatic juice appears to have no effect upon the gastric flora. In 5 cases where stagnation existed in the jejunal loop, the presence of a peculiar, short fat, deeply staining, acid-fast bacillus appeared constant. When it had been observed several times, its presence in large numbers led to the diagnostic suggestion that jejunal stenosis with dilatation might be present, which suggestion was substantiated at laparotomy.

Stool analyses. Altered blood was demonstrated by the benzidin test in 31 of 107 cases studied. Of these, 72 patients were upon test diet.

To 28 patients Schmidt's test diet was given. In 17 cases (60.7 per cent) there was evidence of deficient proteolytic digestion.

Bile pigment (Schmidt bichloride method) was present in all but 8 of 151 stools examined, either as hydrobilirubin or biliverdin. In 7 instances where bile pigment was absent there was deep jaundice. In the remaining case, there existed intestinal obstruction and pronounced cachexia (instance of gastro-ileostomy).

Roentgen examinations. Fluoroscopic study was made of 39 cases within 7 weeks of gastro-enterostomy and of 26 cases operated upon from 6 months to 9 years previously. The results were so greatly at variance with the patient's physiologic digestive function or his clinical condition that we are still in doubt as to the clinical worth of the procedure. Apart from the screen and plate examinations demonstrating the patency or closure of the pylorus or gastro-enterostomy stoma, contractures of the stomach, incorrect surgical procedures, new ulcer or recurrences of ulcer or cancer, or anomalous pocketing or regurgitation of the opaque meal, little reliable information respecting gastric function was obtained. Many of these facts were clinically evident from simple routine examinations and from well taken histories.

In patients who have been operated upon at other clinics and in whom the surgical maneuvers are in doubt, fluoroscopic examinations furnish a valuable method for rapidly establishing the mechanical status of the stomach and the jejunum. However, in all cases, where stenoses, contractures, pocketings, or retention of the opaque meal appear to exist, frequent examinations, particularly after full doses of atropin or belladonna, should be made before opinion is given. Many abnormalities seen at the first seance disappear upon repeated examination, especially upon the examination after anti-spasmodic medicines have been administered.

REFERENCES

1. Smithies. Am. J. M. Sc., 1915, cxlix, 183.
2. Levy and Kantor. Arch. Int. Med., 1916, xvii, 476.
3. Bolton. J. of Path. & Bacteriol., 1915, xx, 133.
4. Paterson. Tr. XVII Internat. Cong. Med., Surg. Sect., Lond., 1914.
5. Goodel. Boston, M. & S. J., 1912, Mar. 28, 487.
6. Panton and Tidy. Quarterly J. Med., 1911, July, 449.
7. Hamburger. Arch. Int. Med., 1915, xvi, 356.
8. Schutz. Beitr. z. chem. Physiol. u. Path., 1904, v, 406.
9. Levites. Ztschr. f. Physiol. Chem., xlviii, 187.
10. Hamburger and Halpern. Arch. of Int. Med., 1916, xviii, 2281.
11. Smithies. Am. J. M. Sc., 1913, cxlv, 340.

THE CHOLESTEROL CONTENT OF THE BLOOD IN GALL-STONE DISEASE[1]

By STANLEY P. REIMANN, M.D., and J. A. H. MAGOUN, M.D., Philadelphia
From the Department of Pathology of the Lankenau Hospital, Philadelphia

An increase in the amount of cholesterol in the blood is stated to occur in the presence of gall-stones, and this point has been used as a diagnostic sign in upper abdominal disease (1, 2). A classification of such cases based on blood cholesterol determinations and a dietetic management has been worked out by Rothschild and Rosenthal (3). A hypercholesterinæmia has, however, been noted by numerous observers in a variety of conditions: nephritis, arteriosclerosis, syphilis, diabetes and many others, conditions which may well complicate cholelithiasis (4, 5, 6, 7, 8). Denis concludes from 254 determinations in various pathological conditions that hypercholesterinæmia is found in only a relatively small number of diabetics and the cases investigated included nine cases of cholelithiasis in which a hypercholesterinæmia was not at all indicated.

Using the original Autenrieth-Funk method (10), blood cholesterol determinations have been made in sixty patients operated on in the clinic of John B. Deaver, to whom we express our thanks for the clinical data. Normal values by this method have been expressed, ranging from 130 to 190 milligrams per 100 cubic centimeters of blood. Several higher figures (230) have been given for individuals (6, 10). Bloor's method (11), in use by several observers who have reported results recently (9), gives readings 7 per cent to 30 per cent higher than those by the Autenrieth-Funk procedure. One person (Magoun) has made the determination in our series and the personal error has thereby been reduced to a minimum. For convenience, in most instances, blood was collected in the morning after the patient had been in the hospital at least over night. We have adopted 200 milligrams of cholesterol per 100 cubic centimeters of blood as the upper limit of normal.

The following table gives averages in the cases with and without stones and gall-bladder lesions.

Number of cases	60
Gall-stones	22
Average cholesterol—219 milligrams per 100 cubic centimeters	
Gall-bladder—diseased and removed	22
Average cholesterol—199.9 milligrams per 100 cubic centimeters	
No gall-stones	38
Average cholesterol—215 milligrams per 100 cubic centimeters	
No gall-stones	38
Other right upper abdominal lesions	16
Average cholesterol—229 milligrams per 100 cubic centimeters	

The stones found varied from 1 to 400 in number and were variously light yellow to black in color, smooth, faceted or mulberry type, from gravel to large stones, 4 to 5 centimeters in diameter. The gall-bladders in these cases showed lesions varying from mild acute to violent suppurative inflammations, from mild chronic inflammatory changes to changes which led to very marked thickening and fibrosis. One case of carcinoma of the gall-bladder occurred among these. The gall-bladders in which no stones were harbored also showed mild to advanced chronic and acute inflammatory lesions. The other upper abdominal lesions found included gastric and duodenal ulcer, high appendicitis, carcinoma of head of pancreas, chronic pancreatitis.

From the above figures it is evident that a high cholesterol content of the blood has not helped in the diagnosis, for the cases of right upper abdominal disease other than gall-stone disease gave higher cholesterol readings than the cases of cholelithiasis themselves. The highest cholesterol reading obtained in the series was 447 milligrams per 100 cubic centimeters of blood in a case of carcinoma of the head of the pancreas; the lowest was 111 milligrams per 100 cubic centimeters of blood in a case of chronic cholecystitis with stones.

[1] Read before the Pathological Society of Philadelphia, June 14, 1917.

Ten patients were jaundiced, all with obstruction of the common duct from stones or carcinoma of the head of the pancreas. The average cholesterol reading was 276 milligrams per 100 cubic centimeters of blood. A hypercholesterinæmia has been found in obstructive jaundice (7, 12), with which our results agree; there was no relationship between the degree of jaundice as observed in the skin and scleræ and the hypercholesterinæmia, however. The patient with the heaviest jaundice, a case of carcinoma of the head of the pancreas, showed a value of 239 milligrams, while a patient less jaundiced also with carcinoma of the head of the pancreas showed a content of 474 milligrams. Plasma jaundice estimations were, however, not made and a discrepancy between jaundice of the blood and of the skin and scleræ may often exist (13).

Cholesterol has been found to increase in the body fat with increasing age (14). The following table shows averages of blood cholesterol in our patients over and under forty years of age, our idea having been that the age may affect the values and thus the diagnostic significance.

Number under 40 years.
  With stones, 9; average 192 milligrams.
  Without stones, 15; average 199 milligrams.
Number over 40 years.
  With stones, 13; average 234 milligrams.
  Without stones, 23; average 219.0 milligrams.

Those patients over 40 years of age, therefore, showed a higher cholesterol value than those under 40. In the younger patients those without stones showed higher quantities than those with stones, the reverse was the case in the older patients, but both of these latter groups showed values above our arbitrary 200 milligrams.

Anæmia produces a low blood cholesterol content (9). Six cases showed hæmoglobin below 65 per cent (Dare) and red cell counts under 3,000,000. Their average of cholesterol values was 213 milligrams. Excluding one case, jaundice, the average is 192 milligrams. Two of these patients had stones (210 and 180 milligrams).

A hypercholesterinæmia has been observed and commented on in malignant tumor cases by various observers (15). Essentially normal values were obtained by Denis in 14 cases (9). Robertson and Burnett have found that the growth of malignant tumors transplanted in mice is hastened by the injection of cholesterol (16). They have expressed the opinion that the increased incidence of tumors as age advances is due to an increase of cholesterol (17).

Among the 60 patients were 9 with tumors, carcinomata of stomach, gall-bladder, œsophagus, appendix and pancreas (2 cases), hypernephroma of kidney, myoma uteri and papillomata of gall-bladder. The average cholesterol reading was 259 milligrams. Excluding the jaundiced cases (2), the average was 231 milligrams. None had gall-stones.

Since gall-stones are more common in women, the cholesterol content of the two sexes in the series had an interest.

37 Females.
  16 with stones, average 225 milligrams.
  21 without stones, average 206 milligrams.
23 Males.
  6 with stones, average 200 milligrams.
  17 without stones, average 203 milligrams.

Viewing the cases from another angle and using 200 milligrams as the upper limit of the normal by the method used, 14 of the 28 cases with stones showed a content above 200 milligrams or about 63 per cent; in the 38 cases without stones 26, or about 68 per cent, gave readings below 200 milligrams.

Cases with stones Milligrams per 100 cubic centimeters		Cases without stones Milligrams per 100 cubic centimeters		
161	285	474	198	265
195	240	214	184	192
210	131	179	180	191
232	334	198	187	287
192	158	382	164	151
212	111	239	184	200
235	311	180	250	148
249	242	240	160	192
175	221	190	190	191
179	244	203	156	172
205	273	253	183	113
		212	170	150
		142	143	

SUMMARY

Cholesterol determinations in the blood of 60 patients with histories relating to upper abdominal lesions were made and their subsequent operative findings correlated to determine the presence or absence of hypercholesterinæmia in cholelithiasis, and their

value as a diagnostic point. Certain complicating and parallel conditions are considered in their relation to the cholesterol readings.

CONCLUSIONS

A hypercholesterinæmia is not constantly present in cholelithiasis. Many conditions may affect the quantity of cholesterol in the blood. Therefore a hypercholesterinæmia has no significance in the differential diagnosis of cholelithiasis.

REFERENCES

1. Henes, E., Jr. The value of the determination of the cholesterin content of the blood in the diagnosis of cholelithiasis. J. Am. M. Ass., 1914, lxiii, 146.
2. Idem. Surg., Gynec. & Obst., 1916, xxiii, 19.
3. Rothchild, M. R., and Rosenthal, N. The dietetic management of hypercholesterinæmia in cases of cholelithiasis. Am. J. M. Sc. 1916, clii, 394.
4. Chaufford, A., Laroche, G., and Grigant, A. Le taux de la cholestérinémie au cours des cardiopathies chroniques et des néphrites chroniques. Compt. rend de la Soc. biol., 1911, lxx, 108.
5. Widal, F., Weill, A., and Laudat, M. La lipemié des brightiques, rapports de la retinité des brightiques avec l'azotemie et la cholésterinémie. Semaine méd., 1912, xxxii, 529.
6. Henes, E., Jr. Untersuchungen ueber den Cholesteringehalt des menschlichen Blutes bei inneren Erkrankungen. Deutsch. Arch. klin. Med., 1913, cxi, 122.
7. Schmidt, H. B. The clinical study of hypercholesterinæmia. Arch. Int. Med., 1914, xiii, 127.
8. Klein, W., and Dinkin, L. Beitraege zur Kenntnis der Lipoide des menschlichen Serums und zur Methodik der Lipoidbestimmung. Ztschr. f. physiol. Chem., 1914, xcii, 302.
9. Denis, W. Cholesterol in human blood under pathological conditions. J. Biol. Chem., 1917, xxix, 93.
10. Autenrieth, W., and Funk, A. Ueber kolorimetrische Bestimmungsmethoden: Die Bestimmung des gesamtcholesterins im Blut und im Organen. Muenchen. med. Wchnschr., 1913, lx, 1243.
11. Bloor, W. R. The determination of cholesterol in blood. J. Biol. Chem., 1916, xxiv, 227.
12. Rothschild, M. A., and Felsen, J. The cholesterol content of the blood in various hepatic conditions. J. Biol. Chem. 1917, xxix, xvi.
13. Hoover, C. F., and Blankenhorn, M. A. Dissociated jaundice. Arch. Int. Med., 1916, xvii, 289.
14. Wacker, L. Das Cholesterin und seine Begleitsubstanzen im menschlichen Depotfett beim Carcinom. Ztschr. f. physiol. Chem., 1912, lxxx, 383.
15. Luden, G. Observations on cholesterin retention as a factor in cell proliferation. J. Lab. & Clin. Med. 1916, i, 662.
16. Robertson, T. B., and Burnett, T. C. The influence of lecithin and cholesterol upon the growth of tumors. J. Exp. Med., 1913, xvii, 344.
17. Robertson, T. B., and Burnett, T. C. The part played by cholesterol in determining the incidence of carcinoma. Proc. Soc. Exper. Biol. & Med., 1912-13, x, 140.

ANGULATION AT THE SIGMOID[1]

By H. BEECKMAN DELATOUR, M.D., F.A.C.S., Brooklyn

THE sigmoid flexure is the narrowest part of the colon, beginning at the termination of the descending colon at the margin of the crest of the ilium, and ending in the rectum opposite the left sacro-iliac symphysis. It is retained in place by a loose fold of peritoneum, the sigmoid mesocolon. Treves defines the sigmoid as extending to the third sacral vertebra, thus including what is usually described as the first part of the rectum. It lies not in the iliac fossa but partially or completely in the pelvis. It is not usually S shaped, but a large loop 17½ inches long, more like the Greek Ω, the top of the loop sometimes even touching the right side of the pelvis (Treves).

At either end of the sigmoid is a constriction which Cantlié[2] describes as a sphincter to which he gives the same importance as to the pylorus. He describes the sigmoid as an organ with a definite function and not a mere channel for the passage of fæces. The mucosa of the sigmoid is not so loose as in other parts of the colon.

It is a well-known fact that the sigmoid mesocolon varies much in length and this leads to varying degrees of mobility with occasionally a twisting of this upon itself producing volvulus.

If, as Cantlié claims, there is sphincteric action at either end of the sigmoid it must be possible for spasm to occur here and thus to impede the flow through the intestine at this point, just as we see cardiospasm and pylorospasm at the stomach.

These anatomic and physiological factors may easily lead to a partial or complete stoppage of the fæcal flow through the large bowel and thus become an important factor in the production of intestinal stasis.

If the bowel twists completely on itself we have produced volvulus with the symptoms of

[2] J. Tropical Med., 1915.

Fig. 1. Case 1. Roentgenogram showing redundant sigmoid passing high in the abdomen.

Fig. 2. Case 2. Roentgenogram showing condition similar to Case 1.

[1] Read before the American Surgical Association, Boston, May, 1917.

Fig. 3. Roentgenogram of child showing redundant sigmoid.

Fig. 4. Case 5.

acute intestinal obstruction, but if the sigmoid becomes distended and displaced with the two extremities attached, as they are, close to the abdominal wall, it is easy to see how the bowel may become bent upon itself and an angulation, instead of a twisting, result. This angulation produces a partial obstruction with the symptoms of intestinal stasis.

Angulation at the sigmoid may occur at either the upper of lower attachment. When the bowel becomes distended and coils back into the abdomen, along the descending colon we may have the angulation at the proximal end of the sigmoid, this is rare. It is more common for the distended sigmoid loop to drag downward and to bend the bowel acutely at the rectosigmoid junction. If there is true sphincteric action in the bowel the irritation of this condition may bring about in addition, spasm of this band of muscular fibers. Whatever may be the cause, it is certain that in many cases angulation does occur and is responsible for chronic intestinal symptoms. Occasionally, angulation is the result of external bands which pass across the sigmoid or to contraction following a mesosigmoiditis.

Intestinal stasis as a cause of varying degrees of ill health is a recognized fact. The majority of surgeons are agreed that to overcome this it is not necessary to do the radical operation proposed and practiced by Lane. Experience has shown that the fault may be at some particular section of the large bowel and that a correction of this defect produces just as good results, with less mortality, than the operation of complete colectomy.

Resection of the cæcum, ascending colon, and a portion of the transverse colon is necessary in some cases; in others the freeing of adhesions at either the hepatic or splenic flexures or the overcoming of a prolapsed transverse colon is necessary, while in others as we[1] have already shown, the cause is found in a relaxed sigmoid that angulates itself at times and requires resection of that portion of the bowel for relief.

We are convinced by our own experience as well as that of some of our colleagues that this

[1]Ann. Surg., Phila., 1905, Nov.

condition exists more frequently than is generally recognized. It can always be demonstrated by the X-ray.

The symptoms are persistent and obstinate constipation, weight in the pelvis or left iliac region, pain in the back over the sacrum and occasionally a tumor may be felt in the left iliac region. This is the distended sigmoid, and will often disappear after the use of an enema.

Angulation may be so acute that complete obstruction is produced and then all of the symptoms of intestinal obstruction appear.

The treatment consists in resection of as much of the sigmoid as is necessary to straighten the canal and prevent a recurrence of the condition. In a few of our early cases we produced an anastomosis between the two limbs of the sigmoid but have been better pleased with the results after resection. The operation is easy of performance and is accompanied by very little shock.

It is well to pass a rectal tube beyond the point of suture before the abdomen is closed and to leave this in place for 48 hours. This relieves the patient of gas and prevents any pressure, on the line of suture.

We have records of about 40 cases from which the following will serve as illustrations:

CASE 1. Woman, age 36, a patient of Dr. J. J. Masterson, had suffered for many years with intestinal symptoms, flatulence and obstinate constipation, pain in the sacral region and a feeling of fullness in the pelvis. Had been operated upon before coming under our observation and the appendix was removed and the gall-bladder drained without benefit. The roentgenogram (Fig. 1) showed a redundant sigmoid passing high in the abdomen.

Operation with resection of twelve inches of the sigmoid was followed by a disappearance of the symptoms and relief of the constipation.

CASE 2. Male, age 65, a patient of Dr. H. W. Price, was seized with pain in left iliac region, distention, inability to move the bowels for several days, tenderness, and a mass in the left side of the abdomen. There was no fever and the patient was able to be about. After the bowels were moved the tumor gradually disappeared and the intestinal symptoms cleared up. The roentgenogram (Fig. 2) showed in this case a similar condition of the sigmoid. The mass which had been plainly felt by three different examiners was thought to be a malignant growth of the colon. It has since disappeared and the X-ray examination shows no constriction or irregularity of any point of the bowel other than the enlarged sigmoid.

CASE 3. Reported by Dr. R. M. Rome[1]. "Male, had suffered for fifteen years with chronic intestinal stasis with marked auto-intoxication with frequent and severe attacks of gout. A year ago (before the report), was operated upon and a redundant sigmoid found and ten inches resected. He has not had an attack of gout since the operation, no evidence of intoxication and only occasionally has to use a cathartic."

Fig. 3 is an X-ray of a child (patient of Dr. Chas. Cochrane) showing that the same condition is present early in life.

CASE 4. Boy, age 6, had always been markedly constipated and would pass three or four days without an evacuation. The use of an enema would produce a free evacuation, but as this was always followed by a convulsion the mother would delay its use as long as possible.

Operation revealed a general ptosis of the transverse colon and a long displaced sigmoid. Seven years ago operation was performed so as to relieve the condition at the sigmoid, the center of the prolapsed transverse colon was anastomosed to the lower segment of the sigmoid thus producing a straight canal. Since then there have been no convulsions and only occasionally are cathartics necessary. He has developed normally and today is perfectly well.

CASE 5. Woman, age 55, a patient of Dr. Roger Durham, "has had several attacks of constipation lasting for several days, with abdominal pain and at times a mass in the left iliac fossa. Between attacks patient suffers from discomfort and constipation which latter dated from the primary attack. Two days before admission a sudden sharp pain occurred in the left iliac region, spreading soon over the entire abdomen. This was dull in character and was succeeded by vomiting when any nourishment was taken. Vomitus was not fæcal. All attempts to move her bowels had failed. Examination showed an elderly appearing woman, of fair nourishment, who did not seem critically ill. The abdomen was generally distended, not tense and fuller on the left side. A mass as large as a child's head could be felt in the left iliac region, tender to touch, and so much so that a careful determination of the nature and limits of the mass was impossible. Attempts to move the bowels by enemata were ineffectual. Under anæsthetic, the same mass could be felt by vagina, and seemed to be a distended coil of intestine. During this manipulation a gurgling sound was heard, and the mass disappeared, co-incidently with a copious evacuation per rectum.

The patient was sent back to bed, the bowels were thoroughly emptied, and a roentgenogram taken of the sigmoid. This revealed an hypertrophied loop of sigmoid about a foot long. This was evidently the cause of the attacks of bowel

[1] Long Island M. J., vii, 252.

obstruction due to the twisting and consequent occlusion of the gut.

At the end of a week the patient was operated upon through a left rectus incision, and the loop of sigmoid, about a foot in all, was excised, and an end-to-end anastomosis done. A long rectal tube was inserted past the line of anastomosis. The bowles moved on the fourth day, at which time the tube was removed, and several times each day following, without cathartics. There was some wound infection of the superficial layers, and the patient went home at the end of five weeks cured.

Not all of the patients operated upon have been relieved of all of their symptoms, but in all there has been improvement, and in most constipation has been overcome completely.

MALIGNANT NEOPLASM OF THE THYROID WITH METASTASES IN THE INTESTINE AND IN BONE

By J. F. BINNIE, A.M., C.M., F.A.C.S., Kansas City

MALIGNANT neoplasms of the thyroid are not particularly rare. Their histologic appearance is most confusing as different areas of the same neoplasm may present entirely different pictures. The following case is reported because of the peculiarity of the metastases which occurred:

Mr. T. K., age, 53. *Previous history.* For many years constipation and indigestion. Right inguinal hernia easily controlled by truss. Thirty years ago penile sore diagnosed as luetic and treated for three or four months. No further luetic symptoms. For twenty years has noticed that larynx has been deviated to the right. Recently has noticed a small hard lump in the region of the thyriod.

History of present illness. About three weeks ago much abdominal colic and distention relieved in a few days by purgatives and opiates. On June 4, 1916, there was severe colic. The bowel was emptied by enemata. Since then there has been no passage of any kind from the bowels. There has been slight vomiting. Opiates give little relief. Late on the evening of June 5 the patient was seen by Dr. H. O. Leonard who found him suffering from severe intermittent colicky pains. The oral temperature was 95.5°, rectal 99°. The pulse was 68, irregular. The extremities were cold.

On June 6, 1916. I saw the patient with Dr. Leonard. The temperature was 97°, pulse 60, fair. The upper right quadrant of the abdomen was rigid and somewhat distended but the distention disappeared under gastric lavage. The diagnosis of acute intestinal obstruction was easy and as operation was imperative, no further examination was made.

Fig. 1. Segment of the gut showing the tumors.

Under gas-ether anæsthesia, the abdomen was opened through the right rectus. Congested small intestine presented and was followed in the direction of increasing congestion until a point was reached which showed a marked dimpling. The dimple was the base of an intra-intestinal neoplasm. Several such neoplasms were discovered, two of which were causing dimpling. The mesentery was thick and œdematous especially at its root. One Peyer's patch was visible through the intestinal wall which was thick throughout the diseased area. A lateral anastomosis was made between points above and below the diseased segment which was then excised. (The length of the excised segment measured 15 inches *after* preservation in Kaiserling's solution.) Recovery took place without complication.

The intra-intestinal tumors consisted of multiple polypi, the two largest of which were about the size of pigeon's eggs Fig. 1. The specimens were given to Dr. A. E. Hertzler for examination.

November 29, 1916, the tumor of the thyroid has steadily increased in size, causes no pain but does cause dysphagia and a persistent hacking dry cough. The tumor is nodular, very hard, not adherent to the skin. It moves with the larynx in deglutition; extends from opposite the upper hyoid cornu to about one fingerbreadth above the clavicle and is about two inches wide.

On the outer and posterior surface of the upper end of the right humerus is a tumor about twice the size of a hen's egg, situated beneath the insertion of the deltoid. This tumor is smooth, rounded, elastic, tender, and has developed in about five months. The X-ray shows that the tumor has eroded about two-thirds of the thickness of the humerus to which it is attached.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2. Mass removed from the humerus.
Fig. 3. Thyroid mass reduced one-half.

Fig. 4. Cross section of thyroid mass.

Dr. J. N. Sherman who has had charge of the patient recently has treated him with mercury and cacodylate of soda because of the luetic history. Under this treatment the patient gained 17 pounds in weight (of this he has now lost 6 pounds) and is less troubled by cough and dysphagia. One Wassermann test was said to be positive and another was negative. At this time a belated report was received regarding the intestinal tumors removed nearly six months previously. They were reported to be malignant and to consist of thyroid tissue or at least of tissue belonging to the endocrine system.

Diagnosis. Sarcoma of the humerus. Malignant neoplasm of the left lobe of the thyroid.

December 11, 1916. The tumor was excised from the shoulder (Fig. 2). A hard walled cavity about 2½ inches long was left in the humerus. This cavity was filled with crystals of boracic acid and the wound closed with out drainage. Healing *per primam.*

December 30, 1916. Under gas-ether anæsthesia the left lobe of the thyroid was excised. It consisted of a nodular tumor (Figs. 3 and 4) of almost wooden hardness. In spite of a postoperative lobar pneumonia the patient recovered and left the hospital on January 19, 1917.

April 18, 1917, Dr. Sherman reports that there is recurrence of the sarcoma of the humerus; that his weight remains about the same as when he left in hospital; that a mass can be palpated in the region of the right kidney; that the urine has a specific gravity of 1010 and contains some albumin and tube casts.

Microscopic examination showed that the tumor of the humerus was a soft spindle cell sarcoma, while that of the thyroid was identical in structure with the intestinal polypi removed six months previously.

Professor William H. Welch of Johns Hopkins University was good enough to examine sections of the neoplasms removed and reported as follows:

I. *Section from the thyroid gland.* This is a section of a tumor said to occupy the left lobe of the thyroid gland. There are no recognizable follicles containing colloid, so that the section does not reveal the origin of the tumor.

The section shows a neoplasm composed predominantly of large, fusiform cells arranged obscurely in interlacing bundles (Fig. 5), although there is no very definite architecture. In addition there are many large polyhedrical and polymorphous cells, sometimes in clumps, and likewise some scattered and focal lymphoid cells. There are some areas, usually round, which may correspond to the original follicles, but these are filled with tumor cells, and it does not appear that epithelial cells participate in the composition of the tumor. The nuclei are in general large, often very large, even gigantic, and contain much chromatin. There are quite irregularly shaped, budding nuclei. There is some connective-tissue stroma, but in general the cells greatly predominate.

II. *Section* said to come from near the upper end of *humerus.* Here again there is nothing in the section to indicate its site. The tumor growth in this section is of the same general character as that described above as from the thyroid — large spindle cells, round, oval or irregular polymorphous cells, often in clumps and columns and connective-tissue stroma (Fig. 6). There are also large cells in the budding nuclei. There is some tendency to an arrangement of cells in small columns and clumps in the outer wall of blood-vessels.

III. *Section from the small intestine.* Here the coats of the intestine can be made out. Over about two-thirds of its extent the section shows a tumor occupying the site of the mucous and most of the submucous coats and projecting about 5 or 6 millimeters above the level of the adjacent mucous membrane. The remaining parts of the section show relatively intact mucous and submucous coats and throughout the section the muscular and serous

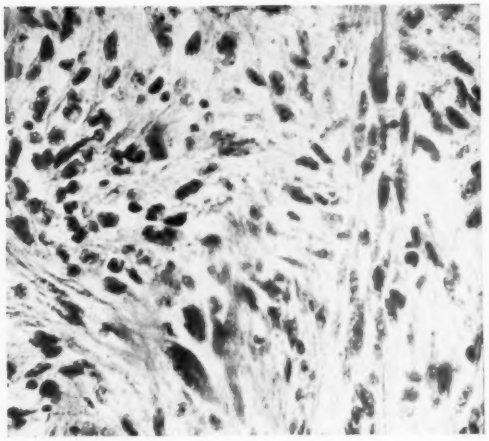


Fig. 5. Section of thyroid tumor.

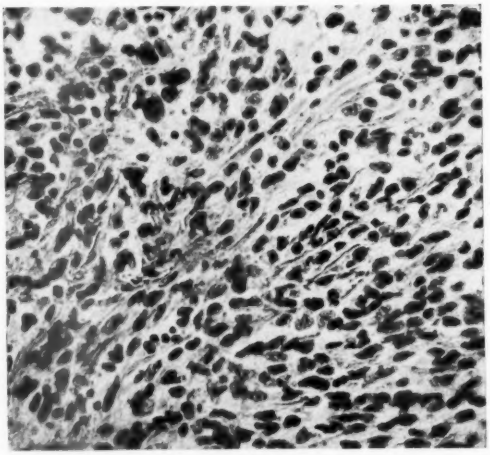


Fig. 6. Section of tumor of the humerus.

coats, the latter moderately thickened by new connective tissue, are present. Over the tumor the mucous membrane is destroyed and the tumor is covered with a purulent or mucopurulent layer about a millimeter in thickness. The mucous membrane with villi and glands of Lieberkuhn can be traced along one edge of the tumor.

In this section (Fig. 7) the tumor cells are in general larger and more irregular in shape than in the sections from near the humerus and the thyroid. They have abundant cytoplasm and large nuclei and nuclear figures are seen. There are fusiform as well as round, oval and polyhedral cells, and the stroma is scanty so that cells occur in clumps and even in syncytial masses. In places, especially near the mucous membrane on one side, there is a distinct alveolar arrangement of the cells.

The submucosa beneath the tumor is chronically inflammed, and shows abundant fibroblasts and wandering cells, which are present also in the muscular and subserous coats.

Diagnosis and remarks. The tumors of the thyroid and of the neighborhood of the humerus are obviously sarcoma and are similar in structure. The interesting question is the nature of the intestinal tumor and its relation to the other tumors. I am of the opinion that the intestinal tumor is also a sarcoma and, although differing in certain features from the structure of the other tumors, is still sufficiently like them to make it probable that all three tumors are essentially of the same character. The intestinal tumor shows larger cells and in places an alveolar arrangement, but the cells do not impress me as of epithelial origin and the alveolar arrangement is not like that of true cancer, the same kinds of cells occurring scattered in the stroma as occur in the alveoli. It seems probable that such differences as exist in the three tumors can be explained by the differences in the sites of their growth.

Upon the assumption which I entertain that the three tumors are sarcomata of essential similarity the question arises which is the primary growth? This question can hardly be answered by the microscopical examination alone. I understand that the intestinal tumor was removed by operation in June 1916 and that the tumor near the humerus and that of the thyroid were observed subsequently. This suggests that the intestinal tumor is primary and the others metastases. Were it not for this sequence, I should be more inclined to regard the thyroid tumor as the primary one, as this is an unusual seat for

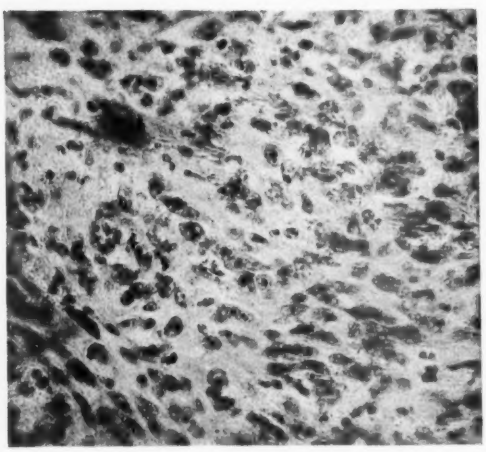


Fig. 7. Section from the tumor of the gut.

metastasis of a sarcoma, still of course metastases can occur anywhere.

While I think it is possible that the intestinal tumor is an independent growth, it seems to me that the characters of all three tumors are reconciliable with the view that they are all of the same nature and this is a simpler conception than that of multiple primary neoplasms.

It will be noted that while the tumor of the thyroid was removed about six months after those in the intestine yet its presence had been noted before the acute intestinal obstruction demanded enterectomy. Thus the sequence of events is not against the assumption that the thyroid tumor was primary.

If the tumor in the thyroid had been metastatic it would probably *not* have involved the *whole* of the affected lobe as it did in this case, but would have been in the form of a nodule or nodules scattered throughout a mass of more or less normal or at least recognizable thyroid tissue. For these reasons there seems little doubt but that the primary disease was located in the thyroid while the osseous and intestinal neoplasms were metastases.

Paul F. Morf[1] made a careful review of the literature relating to sarcomata of the thyroid, finding records of but 40 cases which he considered certainly authentic and among these there were only two which presented metastases in the gastro-intestinal tract. One of these cases reported by Kobler[2] was that of a spindle-celled sarcoma of the right lobe of the thyroid with metastases in the liver, the upper ileum and the right kidney; the second case was reported by Pick.[3] The tumor was a spindle-celled sarcoma with bony tissue in the left lobe of the thyroid, and had been present many years. There were metastases in the lungs, heart, liver, stomach, intestine, pancreas, dura mater and palate.

In six cases metastases were noted in the bones or cartilages.

[1] J. Am. M. Ass., 1899, April 29.
[2] Wien. med. Wchnschr, 1886, No. 9.
[3] Ztschr. f. Heilk., 1892, xiii.

CANCER IN THE SURGICAL CLINIC OF THE SAN JUAN DE DIOS HOSPITAL

With Report of Cases

By DR. J. B. MONTOYA Y FLOREZ, Medellin, Colombia, South America
Member of the Medical Faculty of Paris (1898); Professor of Clinical Surgery, Antioquia University

IN my surgical clinic at the Hospital of San Juan de Dios, during eleven years there have been extirpated 247 benign tumors, 157 external and 90 internal. In the internal are included 47 uterine fibromata (23 per cent) and 29 benign ovarian tumors (11.7 per cent). During the same interval there have been operated upon 168 malignant tumors, 102 external and 66 internal. In the internal are included 43 uterine cancers, 25 per cent of the total malignant tumors, 32 situated in the cervix and 11 in the uterine body; 12 gastric cancers, 7.6 per cent; 5 of the liver, etc. Of the external malignant tumors, 26 were mammary cancers, 15 per cent; 17 were maxillary osteosarcomata, especially superior; 7 of the lower lip; 5 of penis, etc. There were, therefore, operated on an average of 15 cancers per year. The total of the neoplasms operated on in 11 years is 415, that is an average of about 37 per year. As the total operations of all kinds in the same length of time is 1921, the neoplasms equal 21.6 per cent, or a little less than one-fourth of all the operations carried out in the clinic. From this analysis it appears that the form of cancer most frequent in the Antioquia is that of the uterus, viz., 25 per cent; next that of the mammary glands, 15 per cent; sarcoma of the upper maxillary, 10 per cent; cancer of the stomach, 7.6 per cent; of the lips 4 per cent; of the liver and penis re-

Myxolipomatous tumor of parotid gland.

spectively 2.3 per cent, etc. Sarcoma is frequent in the lower limbs, attains large size, and has a grave prognosis, since recurrence is frequent, unless there is wide extirpation. Patients with such tumors are very sensitive to anæsthetics.

The parotid is a common site of enormous mixed tumors. Its extirpation has a fair prognosis (see the photographs).

In civil practice epithelioma of the tongue and of the tonsils is frequent in smokers and drinkers. The cases which come to the hospital are usually inoperable and can only be treated by means of thermic electrocoagulation as G. E. Pfahler, of Philadelphia, recommends; or better by the method of Doyen. The latter method leaves a better appearing cicatrix and differs only in the manner of placing the electrodes. In the United States the method of Percy has given good results. His method consists in applying a low degree of heat with electrocautery regulated by means of a special rheostat of great simplicity. The method is much used by the Mayo Brothers for the electrosurgical treatment of inoperable cancer of the uterus. Donald C. Balfour has published an excellent study of the cases treated in the Mayo Clinic by this method.

The electrocautery, the thermocautery, and the actual cautery are serviceable only in erosive lesions since their action is very superficial, and greatly limited on account of the scar produced by the burning. The scar insulates the neoplastic tissue surrounding it, with asbestos as it were, unless the sessions are repeated ten, twenty or more times, or the scar itself is removed in order to continue in the same session.

Radium is very efficacious in certain cases if the tube is placed *within* the orifice. The ultrapenetrative X-rays can also be used. However, as Doyen has observed, electrocoagulation is the method of choice owing to its particular effect of heating the tissues which are in contact with the small electrode without forming carbonization scars yet raising the organic fluids to a state of ebullition and cooking, coagulating the cancer in a few minutes. The lesser vitality of cancer cells dominates the question of the local thermic treatment of cancer. While it appears that a temperature of 60° is necessary to kill normal cells, 50 to 55° centrigrade appears to be sufficient to destroy the virulence of cancer cells; these coagulate and become disintegrated without secondary hæmorrhage unless the small electrode is placed in a rich vascular region which is a contra-indication as also is the proximity of vital nerves such as the pneumogastric. In such cases air heated to 600° ought to be employed. This is indicated in anfractuous cavities in regions rich in blood supply and nerve trunks, but it works only superficially and does not penetrate more than 3 to 5 millimeters. While electrocoagu-

lation is more difficult to manage penetration can be controlled up to eight millimeters depth, according to time and intensity of current. In this lies the secret of its greater efficacy and superiority over all other procedures employed today.

Fulguration, employed since July 1907 by my master Professor Pozzi, is very efficacious for superficial lesions but useless for deep lesions, since it does not penetrate to more than five millimeters and forms protective scars. American surgeons especially recommend it for the treatment of the wound after the extirpation of a cancer, or for the treatment of a recent cicatrix. In such cases it is applied in the form of large sparks of high frequency with the brush electrode or vacuum tubes and not with pointed electrodes and short sparks, which produce a considerable thermic effect and are perfectly useless in such cases.

Its heralded superiority is due to its marvelous and rapid action in the treatment of benign papillomata of the bladder; its action is specific and is now accepted as the very best, as can be seen from the works of all the great urologists, especially Edwin Beer, its promoter in New York, and Legueu, the most notable in this specialty, and to whom I owe extreme gratitude, particularly to my most noble master Professor Felix Legueu, the dear friend and admirable orator of the Faculty of Paris.

The only unquestionable progress today in the treatment of accessible cancer is the electrosurgical method, which has made a rapid flight into favor, and has given most satisfactory results. Its adoption, however, is and has been slow whether it is a matter of the surgeon being an electrician and mechanic following the delicate technique of Doyen, or whether the surgeon must be aided by a technical assistant as in the large clinics of Europe and of the United States. The most important thing, as William J. Mayo says, is that every precancerous or suspected lesion should not be neglected, and that once the early diagnosis of cancer is made, it be treated, if accessible, by electrocoagulation; on this principally depends the permanent result of the treatment, and physicians ought to realize exactly their responsibility in this respect.

Selenium, eosin, cupresa or electrocuprol, and Doyen serum, which have been tried to a large extent here in Medellin, both personally and by colleagues, have given no benefit whatever and appear to be extremely pernicious, since precious time is wasted, allowing glands to become infected and the neoplasm to spread to vital organs.

I give below a résumé of some cases which I have treated by electrocauterization and fulguration combined, simple fulguration and electrocoagulation:

CASE 1. F. P. V., man, age 64, married, white, Colombian. A brother and an uncle died of cancer, one in the chin region and the other in the tongue. He was neither alcoholic nor syphilitic, but a great cigar smoker. He was a farmer by occupation. For many years he has suffered from a fissure in the left angle of the labial commissura. For two years past the corresponding part of the cheek on the inside has become ulcerated, and since a year ago a warty tumefaction has appeared in the labial commissura and in the lower lip as far as the middle. On April 2, 1915, I cauterized him with the electrocautery, repeating every fifteen days. The cheek ulcer disappeared at the fourth seance, and that of the commissura at the tenth. The lip lesion was treated by two fulguration sessions each of a minute's duration under local cocaine anæsthesia. Primarily it appeared inoperable unless by an extensive autoplasty, since its aspect was very serpiginous and the glands on the same side had apparently become involved. Now they are imperceptible, the general state satisfactory, the color rosy. Up to May 30, 1917, no recurrence has been noted.

CASE 2. A. J. de M., woman, age 65, married, white, Colombian. Antecedents of no importance. Marked arthritis. Seven years ago there appeared on the right side of the upper lip a small purple red placque which was indurated. Later it became covered with a thick scab which the patient pulled off frequently. In December 1915 it showed the appearance of an orbicular ulcer with hard edges and was very painful, bleeding at the least touch. Six seances of fulguration with local anæsthesia were administered. There was a slight cicatrix. The recovery has been maintained.

CASE 3. J. R. B., man, age 37, single, white, Colombian. Antecedent history unimportant. Fifteen years ago there appeared a serpiginous ulceration on the lower lip simulating a chronic eczema, and resisting all treatment. Submental glands showed slight infarcts. On May 26, 1916, cauterization was done with electrocautery and repeated at eight day intervals. At the third seance there was complete cicatrization which lasted until

September 15, 1916, when ulceration appeared in the middle of the lip. Fulguration for 30 seconds sufficed to form a cicatrix which remained for three months. Then in January 1917 fulguration was again necessary and cicatrization resulted and persisted for a time. The origin of the ulceration is uncertain and the result of the treatment appears merely palliative.

CASE 4. F. O., man, age 57, married, white, Colombian. A year ago an ulceration appeared on the right side of the roof of the tongue which invaded the tonsil and the pillars. Merchant by profession. Cancerous antecedents. Drs. Beer and Hermann of New York diagnosed inoperable cancer. On November 8, 1916, electrocoagulation was applied in three points, to the tongue, pillar, and tonsils, for two minutes, one minute, and thirty seconds respectively; the electrode used was 5 millimeters in diameter; zone of whitish coagulation, double or treble. On the fifth day, pneumonia developed on the right side. The patient died on the eighth day. He had little resistance and was ery cachetic.

CASE 5. R. L., woman, age 65, single, half-breed, Colombian, servant by occupation. Family antecedents unimportant. Heavy cigar smoker, ordinarily with the fire inside as is usual with old women in this country. There have been leucoplakic patches during last eight years; for the past two years she has noticed a painful bulb in the interior of the right cheek. Little by little an extensive ulceration appeared in the mucosa and in the commissura of the lips with another bud upon the lower lip. On examination there was seen an enormous sanious cauliflower-like growth of the interior of the cheek the middle of the lip being markedly invaded and the glands enormous. In the rest of the mucosa there were leucoplakic patches. There are no syphilitic antecedents. In view of the inoperability of this epithelioma, I resolved to try thermic electrocoagulation on November 14, 1916. This was done in the hospital under chloroform anæsthesia. This was repeated on December 1, but the applications were only for ten minutes; on the 15th, the third and last cauterization of 25 seconds was done with local anæsthesia. There has been no recurrence up to now with very satisfactory cosmetic result; the commissura is scarcely narrowed. On February 5 of this year the submaxillary gland and lymph-glands were extirpated.

CASE 6. A. B. de M., woman, married, age 57, white, Colombian, cancer of body of the uterus for about 6 months, with crateriform ulceration invading the fundus. In view of the inoperability of the cancer, electrocoagulation under chloroform was resorted to in December, 1916, and twenty days later a cauterization with air heated to 600° C. There was no great change in the ulceration and the patient died from the disease.

CASE 7. N. N., man, age 60, single, white, Colombian, workman. A year ago a pimple appeared in the right side of nostril. It ulcerated later and became covered with a black, hard, thick and very tenacious crust. The ulcer was the size of a twenty-five cent piece and bled readily. Since the fourth fulguration of 30 seconds' duration he has remained well. The last treatment was given in the early part of January of this year.

The treatment of choice in female mammary cancer is amputation of the gland with extirpation of axillary glands and part of the great pectoral muscle or even both pectorals if necessary, by Halsted's method, which alone may be adequate. It is essential to extirpate the glands even if they appear healthy. If a cancer is not operated on by this method it is better not to touch it because its recurrence is certain and rapid. Incipient cases rarely come to the clinic. In general they appear well advanced and some are quite inoperable. In eleven years I have operated on 26 cases in the hospital by Halsted's method without a death and up to now I have not had to re-operate on any patient for recurrence. One returned with metastasis in the dura mater. She had been operated on six months before for an enormous sarcoma with invasion of the axillary glands. Halsted's operation, executed at the opportune time, is a very satisfactory method. I have never had to regret a lesion of the axillary nerves or vessels.

The treatment of choice of cancer limited to the uterine neck without invasion of the fundus or of the ligaments, that is to say with a uterus completely removable, is Doyen's vaginal hysterectomy, leaving two of his forceps in each ligament, the two larger to be taken out in 48 hours and the smaller renewed if they are loose and left in place for two hours longer. Secondary hæmorrhage is thus avoided, which ordinarily occurs in the tissues which have become adherent to the grooves of the forceps; if these are withdrawn all at one time a vessel may rupture. In case of hæmorrhage it is sufficient to place a Collin speculum and leave it open one or two hours, tamponing its interior with sterile gauze.

This kind of hysterectomy can be executed in ten minutes at most and ordinarily in five; it is the least harmful method which can be done. In eleven years I have operated on 25

cases without a death. Two cases had also vaginal and uterine prolapse which is very rare.

Re-operation for recurrence or metastasis was not necessary in any case. Vaginal asepsis was carried out with tincture of iodine and up to now, I have not been accustomed, as Balfour recommends, to cauterize the neck with the thermocautery before executing the circumcision. This precaution nevertheless appears quite logical. The patients get up by the tenth or twelfth day and leave the hospital by the fifteenth.

In primary cancer of the uterine body, the logical operation seems to be Wertheim's, equivalent to that of Halsted's for the breast, but contrary to this it is an intervention with a very grave immediate prognosis on account of shock in patients with little resistance. But on the other hand it is rarely that a surgeon extirpates all the glands as far as the kidney in order to make a true anatomic dissection, and generally this is limited to the removal of those which are enlarged, three or four as a rule. Ureteral fistulæ or necrosis is not a usual result. In eleven years I have executed in the hospital 9 total abdominal hysterectomies for primary uterine cancer with two deaths. One owing to a chloroform anæsthetic accident at the end of the operation in a very cachetic patient 70 years old. In the other, the operation was very laborious owing to the size of the neoplasm, which was an enormous sarcoma accompanied by a left pyosalpingitis with iliac adhesions.

Secondary cancer of the body with cervical propagation is ordinarily inoperable and ought to be treated by thermo-electric coagulation according to Doyen's method, or else by Percy's method. (The latter is inferior since a scar always forms even if the rheostat is at a minimum; and, as Balfour recommends, the abdomen is opened so that more conveniently an assistant may grasp the uterus and push it against the vaginal cautery after having made a precise judgment of the degree of heat necessary. Patients can get up by the tenth day if the abdomen has been opened, if not by the second day. The uterus is often observed to become movable in about two months with the cervix cicatrized; it is then well to make a hysterectomy for greater security.

CONCLUSIONS

1. In cancer of the uterine cervix without propagation to vagina or to the broad ligaments, vaginal hysterectomy.

2. In cancer limited to the body of the uterus without propagation to the broad ligaments or vagina, simple total abdominal hysterectomy without extirpation of the glands.

3. In cervical cancer with propagation to the vagina or broad ligaments, or endometrical with propagation to the fundus, electrocoagulation or Percy's method in the first place, and if the uterus cicatrizes and becomes movable vaginal hysterectomy four to six weeks later.

4. Cancer of the body with propagation to the broad ligaments and to the cervix in patients with advanced cachexia, electrocoagulation only or Percy's method.

5. In large primary or secondary sarcomata with fibrous degeneration (angio-sarcoma), anæsthetic accidents and shock are very frequent. In general such patients are obese with cardiorenal lesions more or less advanced, and should be submitted to preliminary treatment. If they improve simple total abdominal hysterectomy should be done or else any intervention indefinitely postponed.

REFERENCES

DOYEN, E. Traité de thérapeutique chirurgicale. 3d ed. Paris: 1916.

PFAHLER, G. E. The treatment of malignant disease about the mouth by combined methods. J. Am. M. Ass., 1916, Nov.

PERCY, J. F. The results of the treatment of cancer of the uterus by the actual cautery with a practical method for its application. J. Am. M. Ass., 1912.

BALFOUR, DONALD C. The treatment by heat of advanced cancer of the cervix (Percy method).

Idem. The relative merits of the operations for cancer of the uterus. In Collected Papers of the Mayo Clinic, 1915, vii.

MONTOYA Y FLOREZ, J. B. Algunas observaciones sobre la histerectomia vaginal. An. Acad. de méd. de Medellin, 1897, June.

URINARY EXTRAVASATION[1]

By JOHN A. WOLFER, M.D., F.A.C.S., Chicago

I WISH to present the subject of urinary extravasation for your consideration, because of its importance as a complication to various pathological processes of the urinary tract. This association carries the same relative consideration as perforative peritonitis in diseases within the peritoneal cavity, the latter condition being only partially mastered after due consideration was given its causes, method of development, and its attack before complete intraperitoneal dissemination of the infection. Because of the high mortality rate in cases not properly treated early, and the loss of anatomic parts in many cases which survive the ravages of the disease, I wish to call attention to the possible underlying pathology, early symptoms, and a simple though efficient course of treatment. I shall omit the upper urinary tract, and confine my remarks to extravasation from the male urethra and bladder.

Normal sterile urine causes reaction in the tissues chiefly by virtue of its mechanical irritation when constantly infiltrating over a period of time and in relatively large quantities. Here the reaction and subsequent necrosis is chiefly produced by pressure. Sterile water or even sterile salt solution injected subcutaneously over a period of time or under pressure will produce a similar necrosis of tissue. Concentrated urine will bring about this condition earlier than urine of a normal specific gravity and chemical content. The absorption of urea may sooner or later bring about a toxæmia, but usually after the reaction from the local condition is of sufficient gravity to overshadow it. In order to convince myself that an ordinary amount of sterile urine produces no necrosis, I injected three guinea pigs subcutaneously with varying quantities of such urine, using from 20 to 60 cubic centimeters. There was a prompt absorption with no local reaction. Similar quantities of urine standing twenty-four hours caused no reaction. Intraperitoneal injections of 2 to 10 cubic centimeters of sterile urine produced no destructive lesions in guinea pigs. On the contrary, septic urine is very destructive to tissues. The organisms plus the products of ammoniacal decomposition, which are frequently bacterial in origin, produce a rapid inflammatory œdema and necrosis and sloughing soon follow.

A careful study of some 12 cases under my care during the past four years, has led me to classify urinary extravasation into two major groups:

1. Extravasation of normal urine from the bladder or urethra, when there has previously been no stenosis of the urinary outlet.

2. Extravasation of septic urine, which is practically always associated with urethral stenosis.

Class 1. The causative factor is trauma, such as a rupture of the urethra or bladder from a fall or crushing injury, being frequently associated with a fractured pelvis. It may be instrumental. The infiltration of the urine which is not especially irritating to the tissues, causes a slight reaction, and only when necrosis begins and the destructive ferments are absorbed, does the patient develop signs of acute local disturbance and sepsis. Some of these cases, I am convinced, cure themselves spontaneously by a closure of the perforation and the normal egress of urine. One must not forget that most of these cases go on to a fatal termination if not treated promptly and efficiently, destruction of life being due to sepsis.

As an example of this group, I wish to call your attention to a case under my personal observation:

A man was admitted to the Cook County Hospital with a diagnosis of bronchitis. This diagnosis was made because the patient had a cough and fever. At the time of application for admittance he gave no symptoms referable to the urinary tract. After being in the hospital a short time, he began to complain of discomfort in the region of the bladder, and, on examination, marked tenderness about the lower abdomen. Since the patient stated he had not urinated for some time, he was catheterized, and a very small quantity of bloody urine was obtained. The patient then gave a history of an injury several

[1] Read before the Chicago Surgical Society, April 6, 1917.

days before. Operation disclosed a rupture of the bladder. His local symptoms manifested themselves only after necrosis began.

Another patient entered the hospital two weeks after an injury, developing signs of urinary extravasation just prior to entering. One patient entered three weeks after injury, only then presenting signs of extravasation; another, four weeks after injury. Ten days before coming to the hospital, he noticed a swelling of the perineum and lower abdominal wall. Incidentally this man was sent in with a diagnosis of pneumonia. He had passed his urine up to the time of entering the hospital. The local condition had grown decidedly worse during the day prior to coming to the hospital. This case terminated fatally.

These patients had patent urinary outlets, with clean urine and the symptoms became grave only when gangrene resulted. One patient entered the hospital three days after an injury, in a very critical condition, and promptly died. In this case there was a question as to the previous condition of the urine. Most likely it was septic.

I do not care to go into further detail with this type of extravasation, but would call attention to the mode of treatment, which is apparent to all. In rupture of the bladder, if the urine shows no septic material, the perforation should be closed. If perforation is intraperitoneal, the peritoneal cavity should be wiped out and closed without drainage, unless of course, there is present an unmistakable peritonitis, such as is found in the late cases. In extraperitoneal perforations, the wound is closed and a gutta-percha drain is left in place for 24 hours. In the late cases wide incisions should be made into the œdematous and gangrenous areas. In rupture of a previously normal urethra, the perforation should be closed with fine catgut and a retention catheter left in position for 48 to 72 hours. If the tear is intensive, I would insist on a suprapubic cystostomy, keeping the tube in place 4 or 5 days or even longer, to allow the urethra to heal properly, leaving a tube or catheter in the urethra down to the sphincter of the bladder but not into the bladder. The reason for this I will discuss in another part of my paper. The results are uniformly good, if the patient is operated on within a reasonable length of time after the injury, or before necrosis has taken place.

Class 2. This class constitutes by far the larger group in my experience, and in order fully to understand its mechanism it is well to consider the urinary act. Under normal conditions, the desire to void urine is produced by a stimulation to the interior of the bladder, especially in the region of the trigone. This is usually brought about by intravesical tension. In diseased processes, such as cystitis, there is a frequent desire to urinate produced by (1) increased irritability caused by septic urine, and (2) bladder sensitiveness due to the inflammation or ulceration. We all know that an inflamed bladder will not even tolerate warm water or salt solution. If we remove the intravesical tension-stimulation, the patient experiences much less discomfort.

Stenosis of the urinary outlet, especially of the infective type, is sooner or later followed by infection behind the stricture. This applies to any part of the urinary tract. We know how frequently kidney infections follow stenosis of the ureter and cystitis, after enlarged prostates and urethral strictures. Strictures of the urethra are rarely single in number, there are usually two or more, beginning in the penile part with others at the level of the triangular ligament and in the membranous part. As the stenosis becomes more complete, granulations form between and behind the strictures, and the urethra becomes tortuous, and pockets form; the bladder wall becomes thickened and a fibrous degeneration takes place, especially in elderly and poorly nourished individuals. The bladder wall loses its elasticity. These processes predispose to complicating pathology, such as prostatitis, seminal vesiculitis, periurethral abscess, and the like. Their relation to extravasation will be referred to later. With these points in view, let us now turn to the causes of extravasation in this group.

1. *Stricture of the urethra with retention; suprapubic puncture of the bladder.* When I was an intern in the Cook County Hospital, it was a stated fact among the interns that a suprapubic puncture meant death to the patient. This was told me early in my service, after I had resorted to this procedure late one night in a case of urinary retention. The following day a member of this society did

a perineal drainage of the bladder, and in spite of this, the patient died of sepsis some 36 hours later. This was only another case added to the many that had preceded. Now there must have been some very good reason for giving me this advice, and furthermore there must be some explanation for this grim fact. A case under my care some two years ago enlightens me considerably:

A man entered my service at the Cook County Hospital, with a urinary retention. He was of the type so frequently seen there; on the verge of an alcoholic delirium. He had taken, according to his own statement, nothing but whiskey during the previous 4 or 5 days. He had a marked arteriosclerosis with an arterial hypertension, and was an exceedingly poor surgical risk. We were unable to pass even a filiform through the urethra, and I advocated a suprapubic puncture. This was done and I instructed my interns to watch the patient most carefully. Following the use of hot sitz baths and opium, he was later able to pass some urine *per urethram*, but soon developed an area of swelling and tenderness in the right inguinal region. Under gas anæsthesia, a hurried suprapubic cystostomy was done, and an exploration of the area of tumefaction. Here urine and pus were found, urine which had been forced through the puncture wound into the space of Retzius, thence passing under the abdominal wall to the right, along the transversalis fascia. This man was fortunate in that the quantity was small and the urine not highly infectious.

What happens is this: following the puncture and emptying of the bladder, as a rule, it quite rapidly refills. The bladder is very irritable due to the previous overdistention, and almost immediately the patient tries to void his urine. The stenosis is still present. Due to the fibrous condition of the bladder wall, the opening made by the trocar, though small, does not close properly and urine is forced through it. The urine now may extravasate in several ways. It may be more or less confined in and about the space of Retzius. This rarely happens. It usually follows around the bladder on either side and enters the loose areolar extraperitoneal space. We know that this region is very dangerous territory for infection. There is a rapid spread in the retroperitoneal tissues, early absorption, with sepsis and death, before any localizing symptoms appear. Furthermore, there is no way to efficiently drain this region. When this space is once infected, drainage of the bladder is of no avail. If suprapubic puncture must be done, and in my mind it has a field of usefulness, a fine caliber needle should be used, and drainage of the bladder instituted within a period of a few hours.

2. Stricture of the urethra, with perforation by an instrument. This condition arises only too frequently. During the past 4 years, I have had three such cases on my service. All of these patients give a history that a partial or complete urinary retention bring them to a physician for relief, and that following soundings or attempts at catheterization, force being used, they develop the extravasation, the onset of symptoms, and the type, depending on the location of the tear, the condition of the urethra, and the nature of the urine.

In order to understand fully this type of extravasation, it is well to review briefly the anatomy of the perineum and urethra, and to call attention to points on stricture, previously mentioned in this paper. The dividing planes of the perineum are the fascia and the folds of the triangular ligament. The superficial membranous layer of the perineal fascia is attached laterally to the pudic arch; posteriorly to the triangular ligament; anteriorly, it continues up over the cord and abdominal wall; and medianly to the shaft of the penis. The triangular ligament is attached laterally to the pudic arch, and its base fuses with the superficial fascia. This divides the perineum into two more or less closed compartments, the membranous urethra lying behind the triangular ligament.

The urethra, for convenience, may be divided into four parts; penile or cavernous, the bulbous, lying anteriorly to the triangular ligament and partially posteriorly to the deep layer of the superficial fascia, the membranous, lying behind the triangular ligament, and the prostatic. The membranous urethra is the narrowest, and at this point the urethra takes a rather sharp curve upwards. Due to this curve and to the fact that it is more or less fixed by the triangular ligament, it is most likely to be perforated by a sound. From this it will be seen that in case of a perforation of the membranous urethra, the urine will fill the deep space behind the

triangular ligament. Under pressure, the urine will either perforate the deep pelvic fascia and enter the perivesical space to appear about the bladder and in the space of Retzius, or perforate the triangular ligament and appear in the anterior space. A perforation in the anterior space allows the urine to follow the course of the superficial fascia. Due to the lateral attachment of the fascia, the urine does not, at least early, invade the buttock or thigh, but ascends to the scrotum and anterior abdominal wall.

As stated before, the history that most of these patients give is that, due to an inability to urinate, they present themselves to a physician who attempts to catheterize and forces an instrument through. Due to the peculiar condition of the urethra, with multiple strictures, the instrument probably passes one or more of these obstructions, and encounters the stenosis so frequently found in the membranous portion. Here, due to the resistance of the stricture, the instrument perforates the urethra and enters the deep compartment. This portion of the urethra may be the seat of ulcerations which increases the danger of perforation. Being unable to relieve the patient of his retention, he is sent to a hospital, and during this interval there is a constant effort at urination. Some urine undoubtedly passes the deep stricture and due to the traumatic œdema of the stricture passed by the instrument, and a subsequent closure, the urine, septic in these cases, passes into the deep compartment.

Not infrequently, the patient has a chill at this time, and only too frequently is it called a "urethral chill," and no especial attention given it. The surgeon may interfere at this time by doing a suprapubic puncture, but the damage is done. Fever may be present, but it is usually of a low grade. The pulse is rapid. On careful rectal examination, a distinct area of fullness can be felt at the level of the triangular ligament. This area is very tender to touch. The mistake made at this time on rectal examination is that the tip of the examining finger is inserted too high up in the rectum feeling for the prostate. The area in question lies just internal to the anal sphincter, anteriorly and laterally.

At this time, suprapubic cystostomy, and incisions laterally in the perineum down into the deep compartment, is all that is required. As a rule the patient makes an uneventful recovery except for the urethral stenosis which will be discussed later. If untreated, the process advances as previously outlined and early gangrene takes place in the deep structures, and soon appears superficially. Very early there is œdema of the penis and scrotum. If the perforation is primarily into the anterior compartment, œdema of the scrotum is earlier and the infiltration soon becomes apparent.

Now as to treatment, I am firmly convinced that in the majority of cases, suprapubic cystostomy, with wide drainage of the infiltrated and œdematous tissues by multiple large incisions, avoiding the urethra, is the only proper procedure. First it reduces the mortality rate and lessens the destruction of parts. Second we avoid persistent perineal fistulæ. In going over the records at the Cook County Hospital for a few years, one sees a large number of persistent perineal fistula, which are for the most part results of perineal drainage of the bladder in the presence of stricture. Their persistence to me is very apparent. The perforation of the urethra is usually behind one or more strictures and anterior to others. In attempting to dilate these strictures, it is almost impossible to avoid allowing the sound to pass through the perforation, thus keeping it open. Sounding is absolutely necessary to good end-results, whether the perineal or suprapubic method be used. The urine is septic and each time the patient urinates most of the urine passes through the fistula. More scar tissue is produced and in the end all the deep urethra, periurethral tissues and skin are involved in a massive cicatrix. These cases are almost hopeless, so far as the functional cure is concerned. In suprapubic drainage, we have a better chance. Due to the absence of intravesical tension, the patient does not desire to urinate. The sphincter remains closed. After the infection in the bladder has been cleared and the perineum has more or less righted itself, cautious attempts at soundings can be resorted to. If impossible to get through

the deep stricture pass a filiform from the bladder through the stricture and thread a grooved sound over it. In this manner the stricture can be properly dilated, and no urine will pass through the perforation, which in these cases, rapidly closes. When I am sure the perforation is healed, and the urethra dilated to pass a French 30 sound, I allow the suprapubic wound to close and it will close spontaneously. In some instances where there is a large tear in the urethra with an especially resistant stricture, after once passing through, I leave a rubber catheter in position. The catheter does not enter the bladder, but extends to the sphincter. I believe a catheter into the bladder is undesirable, as some urine escapes around the catheter and through the fistula. It also has a tendency to allow a closure of the suprapubic wound unless a tube is in place.

3. *Stricture of urethra with perforation due to infection.* In my mind this group affords the most interesting material, the study of which prompted me to present this paper.

In going over the histories of the Cook County Hospital for the past four years, I have found thirteen cases, not including my own seven cases. The mortality is 35 per cent.

These patients were admitted to the hospital with varied diagnoses: two entered as pneumonia, due to onset with chill; one as typhoid, because of fever without assignable cause; one as malaria, because of frequent chills; one developed in the hospital in a patient suffering from a myocardial disease; one died in the medical service without surgical interference, a diagnosis not having been made until the patient was moribund.

The mechanism of this type of extravasation deserves consideration. As I have previously stated in this paper, there is usually infection behind a stricture. Granulations are frequent and possibly ulcers are present. Due to the excessive intra-urethral pressure during attempts at urination in the presence of either partial or complete retention, there may be a perforation through the base of an ulcer. What more frequently happens a peri-urethral abscess forms. The abscess due to its peculiar location may not make itself apparent to inspection and not be found by the ordinary examination. This is especially so when the process takes place in the posterior compartment of the perineum. The patient may have a chill and sweats with fever. The abscess spreads, it may burrow into the pelvis or make its appearance in the perineum or upper scrotum. The urethral side of the wall, thin and necrotic, is broken by the urinary pressure in the urethra, and extravasation takes place into the cavity and subsequently into the surrounding tissues. The perforation of the urethra into the abscess or vice versa, may take place before the presence of the abscess is determined, as in Case 5. This deep-seated, unrecognized infection accounts for the repeated errors in diagnosis. With the perforation there is a rapid œdema of the perineum, scrotum, and penis, even the anterior abdominal wall and inner surface of the thighs, at times. The patient manifests symptoms of shock. The temperature may fall and the pulse be accelerated. Rapid disintegration of the tissues results, and only too frequently, in spite of efficient treatment, death results. One patient told me that after the "breaking," as he called it, he could urinate, but passed nothing *per urethram*, and he was much concerned as to where it went.

The symptoms before perforation are somewhat confusing, and can be attributed to a variety of conditions. The fever and other septic symptoms may be caused by cystitis, acute non-suppurative prostatitis or seminal vesiculitis, ascending urinary infections or pyelitis. When we have a patient with a partial urinary obstruction, who develops a chill and fever, the perineum should be examined very carefully, as previously described. Unless great care is taken, this essential diagnostic point is lost. It must be remembered that at this time the symptoms and findings are those of periurethral abscess. When such a patient suddenly develops a urinary retention, something must be done, and that must be surgical; we must drain the infection and relieve the retention. A sharp pain in the perineum with the sense of something breaking, often associated with a chill and drop in temperature, increase in pulse rate, with rapid developing œdema of penis and scrotum,

means rupture of the urethra and beginning urinary infiltration.

The treatment is the same as for the previous type; suprapubic cystostomy, and free drainage of the œdematous and infected parts.

I wish to give brief histories of seven such cases, which have been under my care during the past four years, omitting all history except as bearing on condition in question. The histories are exact copies of the data and observations recorded by the resident physicians and are given for the purpose of illustrating the indefinite symptoms in each case.

CASE 1, P.S., age 40, laborer, entered Cook County Hospital March 16, 1914. One week ago the scrotum began to swell and to be painful. The swelling increased and by Monday, two days ago, the scrotum began to grow black. The patient has no trouble in passing urine and believes he urinates as much now as before. Sixteen years ago the patient had gonorrhœa. Since then whenever he is exposed to cold and wet in his work as a laborer he would have acute retention of urine which usually would last only one day and the next day he would be able to urinate, but for next few days, urination was painful. These attacks were rare in summer.

Examination of genitalia. Blackened area of gangrene on penis the size of a quarter. The scrotum is swollen about four times normal size; red, tense and tender. There is gangrene of the dependent one-third. There are sinuses on the upper surface from which urinous pus escapes. There is infiltration of the lower part of abdominal wall up to internal inguinal rings. This area is red, swollen and indurated. Temperature 97.6°; pulse 120. There is a tight stricture at the membranous urethra. Catheter treatment incisions. Recovery.

CASE 2. E.T., age 32, bowling alley man, entered Cook County Hospital July 29, 1914. The patient comes complaining of pain, swelling, and tenderness over scrotum and penis, which began two days ago, and has rapidly increased up to the present time. The patient says he has been unable to pass urine normally for two days. At times he could pass some and at other times only by drops. He had gonorrhœa nine years ago, followed by strictures; infected again three years ago. The scrotum and penis were markedly swollen, œdematous, and very tender. The lower abdominal wall was tender. The bladder is distended. Temperature 100.4°; pulse 128. Suprapubic drainage, incisions in scrotum. Recovery.

CASE 3. H.M., age 34, teamster, admitted October 25, 1913. The patient has been unable to urinate for past two days, a small amount dribbling through urethra at times. Much pain is present constantly. A desire to urinate comes on about every minute. The trouble began seven years ago with gonorrhœa. The patient has known since then that he had a stricture, but this is the first time he had retention of urine. The bladder is distended; the penis and scrotum œdematous; the skin red and shiny. Temperature 98.4°, pulse 96. Perineal drainage. Recovery.

CASE 4. S.J., age 42, laborer, admitted November 17, 1916. The patient admitted to medical service with diagnosis of pneumonia. He complains of chills, sweats, and fever. There is pain in the belly and lumbar region. There is slight cough and constipation. Six days ago patient had a chill which lasted about half hour. The chill was severe enough to cause him to shake. The chill occurred at 6 a.m., but the patient went to work but had to quit at 9 a.m. From that time on has had these shaking chills four to five times a day, followed each time by a profuse sweat, lasting 15 minutes to half an hour, after which he feels hot. He had severe pain in his belly and in the lumbar region, since he had been sick, described as a dull ache, but made worse on deep respiration and on movement. His cough has been very slight, not painful. He has never noticed blood, and has expectorated a very small amount of whitish sputum. He had had no bowel movement since he took sick, until given an enema this morning. Ten years ago, while in New York, he had a about three chills at intervals of one to two days, but was cured by medicine. He has had none since. He had suffered from lead poisoning 14 years ago. He had gonorrhœa at 35 but cured himself in two months. The lungs were negative. He is tender through abdomen and markedly so over gall-bladder region. The mass is palpable here. The genitals are negative. The rectal examination is negative. Temperature 101°, pulse 118. November 18, 1916, blood from urethra after urination; November 20, 1916, urinary retention; November 21, 1916, marked œdema of the penis and scrotum; the patient cannot urinate, and is tender over the bladder; November 22, 1916, penis very œdematous, and shows beginning gangrene. Drainage of bladder. Death.

CASE 5. I was unable to find the history of this case, so will have to depend on memory and a few brief notes. This patient was admitted to the Medical Service of the Cook County Hospital with a diagnosis of typhoid. Here he remained for several days. The white blood count was slightly increased. There was negative Widal reaction. His temperature ranged rather high. He complained of no distinct discomfort but became very toxic. Rather suddenly one afternoon he developed an œdema of the perineum, scrotum, and penis. The scrotum soon became discolored and he was transferred to the surgical service July 26, 1913. His condition was very critical. An incision into the perineum entered a large abscess cavity filled with pus and urine. A finger inserted, entered the urethra and the bladder. Death resulted in a comparatively short time.

CASE 6. M.M., age 68, machinist, admitted to Cook County Hospital October 27, 1916. The patient has been in the hospital before complaining of difficulty in urinating. He now complains of frequency of urination, dribbling, swelling of prepuce and scrotum. He says swelling of the scrotum has been present about three weeks, and has gradually increased in size up to the present time. The scrotum is tense, red, and tender. The skin of the lower posterior part is discolored and appears gangrenous. This swelling extends to the penis and above about two inches along the spermatic cord, also involves the perineal region. The prostate is slightly enlarged. The white blood count is 29,800. The urine is filled with pus. Temperature 98°; pulse 108. The general condition is exceedingly poor. He is in a muttering delirium. Suprapubic cystostomy and wide drainage of infiltrated area. Recovery.

CASE 7. J.A., age 31, cook. Admitted to Cook County Hospital Hospital May 26, 1916. He complains of pain in the perineum, frequency of urination, with burning. There is some pain with bowel movement and fever. Two months ago the patient contracted gonorrhœa and has had a discharge about six to seven weeks. One week ago he began to have a frequency in urination, eight or nine times daily and hourly at night, with some burning. A day or two later the swelling in his perineum between anus and scrotum began, and it has been gradually enlarging until now, including the tissues around the penis and his scrotum. This region became red, but not painful. For two or three days he has had some pain when his bowels moved. The pain he now has is dull in character, and is localized to the area between anus and penis. He has not passed any blood. There is no history of injury. He had fever for four or five days. No chills. He has vomited once. His appetite is poor.

Examination. There is a tender, brawny, firm swelling in the perineum between anus and base of penis and around anus. The scrotum is bright red. There is no tenderness of testicles or epididymis. There is marked tenderness and swelling of prostate and seminal vesicles. Temperature 101°, pulse 118.

A member of the staff incised the perineal mass, obtained urine and pus. Condition rapidly progressed. The following day a mass was palpable just beside the right pubic spine beside the penis. The penis was very œdematous; the patient very toxic. A small quantity of urine passed from the perineal sinus. An incision over the above mentioned area, revealed strong ammonical urine. Suprapubic cystostomy and wide drainage of infiltrated areas.

Recovery. Much subsequent trouble in getting dilatation of structures, due to perineal fistula. Ultimate complete recovery.

The following classification can be made of the 31 cases of urinary extravasation from the urethra and bladder, obtained from the records of the Cook County Hospital, during the past four years:

Extravasation of clean urine due to traumatic rupture: 5 cases, 3 deaths, 2 recoveries, 60 per cent mortality.

Extravasation of septic urine due to traumatic rupture: 4 cases, 1 death, 3 recoveries, 25 percent mortality.

Extravasation of septic urine due to old occluded fistula: 2 cases, no death, 2 recoveries.

Extravasation of septic urine due to inflammatory rupture: 20 cases, 7 deaths, 13 recoveries, 35 per cent mortality.

CONCLUSIONS

In conclusion, I should like to emphasize the following points:

1. Extravasation of clean urine may present few signs early, and not produce marked reaction for a period of time, up to two to four weeks, and then rapidly destroy life by sepsis.

2. Urine in the presence of a stenosis of the urinary outlet is usually septic.

3. Many cases of urinary extravasation are caused by a rupture of the urethra due to an inflammatory process, which can be detected before perforation.

4. Urinary extravasation must be treated according to the condition of the urine.

a. In clean urine cases, closure of the perforation with drainage in case of necrosis is the method of treatment.

b. In septic urine cases, suprapubic cystostomy with wide incisions in all infiltrated and œdematous areas, rest to the urethra, and subsequent careful dilatation of the strictures, is the only safe method of procedure.

BILE PERITONITIS WITHOUT EVIDENT PERFORATION OF THE BILIARY TRACT[1]

By J. J. BUCHANAN, M.D., F.A.C.S., Pittsburgh

EFFUSION of bile into the peritoneal cavity without evident rupture or perforation of the bile tract or alimentary canal has received serious consideration only within the last seven years.

In a few previously recorded cases massive bile effusions have been found at autopsy, when no evident lesion could be discovered. In all such cases, however, the clinical history pointed to a rupture and the parts were in such a pathological state that such a lesion could not be positively denied. A typical case of this kind occurred on August 11, 1783.

A fourteen-year old boy fell from a mulberry tree and struck the ground face down. At noon on the same day he was admitted to Guy's Hospital, London, under the care of Doctor Saunders, who bled him frequently (three times in the first 24 hours), purged him constantly and blistered his abdomen.

Notwithstanding this treatment, the boy was able to be up walking about the ward on the fifth day. His abdomen, however, began to enlarge, and his general condition became progressively worse until the 24th day, when he was tapped in the left lower quadrant and two gallons of yellow liquid evacuated "which answered in every respect to bile. . . . It was bitter, became green on the addition of acids, and when evaporated to dryness, deflagrated with niter."

The fluid reaccumulated, and he was again tapped on the thirty-seventh day. This time the trochar perforated an intestine and the boy died of peritonitis five days later (six weeks after his accident).

The autopsy was performed by Mr. Thomas Skeete,[2] who reported the case at great length and with great accuracy in the *London Medical Journal*, 1785. He found in the abdomen between 2 and 3 gallons of dark bilious fluid, confined by adhesions chiefly to the right side. The liver was removed from the body "with a view to examine its under surface, and to inquire particularly into the state of the gall-bladder and biliary ducts. In consequence of adhesions to the stomach and neighboring parts, nothing satisfactory with regard to the exact place at which the injury had been received could be ascertained."

This is the earliest case which the writer has found of intraperitoneal bile effusion, without discoverable lesion of the bile tract or alimentary canal. There is no doubt, in this case, that a rupture had occurred, probably of the common duct. The fact remains, however, that none could be found at autopsy with the specimens on the table.

At the 1905 meeting of the American Surgical Association, Dr. Maurice H. Richardson,[3] in a general discussion of diseases of the bile tract, stated that, in one instance, he had "found the right upper quadrant flooded with bile which had escaped from a gall-bladder that was apparently normal. Drainage was successful." This is the first suggestion that the writer has found that bile may pass through an apparently normal gall-bladder. Further particulars of this case, regarding the examination of the cystic and common duct and duodenum do not seem to be on record. It is to be supposed, however, that an operator of Dr. Richardson's skill and experience would undoubtedly have made careful examination of these parts.

Five years later, namely, in 1910, Clairmont and von Haberer,[4] assistants of von Eiselsberg of Vienna, reported the case of a patient on whom they had operated on February 10 of that year, evacuating from the peritoneal sac an estimated quantity of 7 or 8 litres of a liquid that had all the gross characteristics of bile. Careful search at both operation and autopsy failed to reveal any perforation of the gall-bladder or bile ducts or of the stomach or duodenum or any spot which could be suspected to be such. The patient was a 64-year old man with jaundice from obstruction of the common duct with a large stone. Owing to the unexpected condition found at operation, no chemical examination of the liquid was made to establish positively its biliary nature. However, neither then nor thereafter did the operators express any doubt that the effusion was bile,

[2] Lond. M. J., 1785, vi. 274.

[3] Tr. Am. Surg. Ass., 1905, xxiii, 217.

[4] Loc. cit. in tabula.

[1] Read before the American Surgical Association, Boston, May, 1917.

It so happened that, prior to this time. Clairmont and von Haberer had made experimental ligation of the common duct in dogs to note the effect of this procedure on the excretion of urine. In 4 of their dogs, the occlusion of the common duct had caused death with intraperitoneal bile effusion without perforation of the bile tract.

These animal experiments, taken in connection with the operative and postmortem findings in their patient, convinced them that they had discovered a previously unnoticed complication of obstruction of the common duct, namely, *a permeability of some part of the bile tract, which, being in a pathological state, permits the transudation of bile into the peritoneal sac, by a process of filtration, when no gross perforation exists.*

Since the publication of Clairmont and von Haberer's paper, 15 additional cases have been published, 7 in Germany, 4 in France, and 1 each in Italy, Switzerland, Sweden and America. It has been assumed by nearly all of those who have reported these cases that the effusion of bile, usually massive, permeated the wall of the bile tract by a process of filtration, without any gross defect, according to the theory of Clairmont and von Haberer. This assumption, however, has been vigorously opposed by a number of authors, who explain the pathological process in various other ways, and by some who question the biliary nature of the effusion itself.

A critical examination of the cases reported shows such a lack of uniformity in the symptoms and course of the disease; in the condition of the bile tract, as shown at operation, autopsy, and by examination of specimens, and in the apparent causes of the changes present, that it must be concluded that the bile effusion in these cases is not the the result of any definite pathological process.

Before making an analysis of the reported cases, it may be well to give a brief history of the personal case which directed the writer's attention to this subject.

The patient, a boy of 12 years, was admitted to the Mercy Hospital, Pittsburgh, February 6, 1916, with the following history: When 2½ years old he had typhoid fever, which confined him to bed for six weeks and from which he made a good recovery; at 3 years he had whooping cough; at 4 years, scarlet fever, with enlarged cervical glands; at 5 years, dysentery, with vomiting, severe abdominal pain and bloody mucous passages. This illness lasted ten days. For the next 2½ years he was never well, was weak and thin, always tired, could not go upstairs without assistance. At the age of 7½ years, he had adenoids removed.

In his eighth year he began to have attacks of abdominal cramp with vomiting of bile. Most of the pain was in the right upper quadrant. He was never jaundiced. Tenderness over the gall-bladder was usually marked. His attacks usually lasted two days and were so severe that the neighbors would say: "Joe is having one of his spells again." During his eighth and ninth years he had about a dozen such attacks, but for the last three years he has had only four attacks.

Ten days before his admission he was in a rather rough game in which larger boys "piled" on him as he lay on the ground. That evening he came home sick with what proved to be an attack of tonsillitis. In 4 or 5 days he was apparently well and returned to school. Two days before his admission he was taken with colic at school and had to be assisted home. The abdominal cramps were attended by nausea and vomiting with slow pulse and but slight elevation of temperature.

The family physician was called and found that practically all of the patient's early pain and tenderness was high up on the right side of his abdomen. At the end of 48 hours the patient was still vomiting, and his pulse was quite rapid; his abdomen was markedly distended and rigid. It was the opinion of his physician, who had seen him in former attacks, that, notwithstanding the patient's youth, the trouble was located in the gall-bladder.

Condition on admission. Patient has the appearance of being seriously ill. Pulse is rapid and temperature but little above 100°. Abdomen is markedly distended and everywhere rigid. There is acute tenderness at McBurney's point and some tenderness over the whole abdomen. A diagnosis of diffuse appendiceal peritonitis was made and immediate operation performed.

Pathological condition found. Peritoneal cavity swimming with a mixture which seemed to be about half bile and half seropus. This gushed out as soon as the abdomen was opened and flooded the floor before a basin could be brought. The intestines were injected and the ascending colon very much thickened. The appendix was reddened, but not more than the other serous surfaces in the neighborhood. It was not otherwise diseased. Peritoneum of the ascending mesocolon and that covering the common duct, œdematous, glassy, and green. Wall of common duct black and apparently totally gangrenous. Gall-bladder tense, red and full of dark bile and muco-pus. Common, hepatic and cystic ducts not obstructed. No perforation to be found in bile tract, duodenum nor stomach, nor

point suspicious of perforation by reason of adhesions or plastic lymph.

Mechanics of operation. Incision at margin of right rectus for exposure of appendix, which was delivered and removed. Incision was freely extended upward, to give complete exposure of the bile tract. The gall-bladder, cystic and common ducts, as well as the stomach and duodenum, were carefully examined for perforation, with negative result. The common duct was exposed by incising the œdematous peritoneum over it, and it was found to be black and apparently gangrenous. It was opened and explored by passing a uterine probe into the duodenum and into each hepatic duct. All ducts were found free from obstruction by stone or otherwise. The mucous membrane of the common duct, as well as its wall, was black and appeared to be in a state of gangrene. This condition of the common duct has a parallel in those unusual cases in which the gall-bladder wall is deeply congested, its mucous membrane black, and which, for one reason or another, are treated by drainage and recover without sloughing.

A rubber drain was passed into the hepatic duct and anchored with catgut stitch to the common duct, whose opening was closed snugly around it. The gall-bladder was opened and found to be free from calculi. The margin of the opening was overwhipped, and the gall-bladder was drained with a rubber tube. Fresh bile soon began to drain from both gall-bladder and common duct. The region of the common duct was protected by two cigarette drains and a rubber tube, the peritoneal cavity was mopped out to remove the bile and exudate that remained, and the abdomen was closed without drainage except as stated.

Subsequent course. The peritonitis subsided at once and the patient made a good recovery, retaining a biliary fistula, with variable flow, for about six months. This was regarded as a favorable factor, considering the previous history of the boy, and the marked condition of his bile tract found at operation. At the end of 6 months the fistula spontaneously closed, and the boy has since remained well.

For a boy to suffer from his eighth to his twelfth year with repeated attacks which, in an adult, would be considered biliary colic, is unusual. The operative findings, however, confirmed this diagnosis, which had been positively held by his medical attendant. The clear history of a severe typhoid fever when the boy was but 2½ years old is very pertinent in this connection. It is unfortunate that cultures were not made of the contents of the gall-bladder to determine the presence or absence of the bacillus typhosus. A postperitoneal traumatic rupture of the common or hepatic duct with infiltration of bile and subsequent infection of the effusion by organisms from the infected tonsils is a strong possibility.

There are two questions, however, of paramount importance in the interpretation of this case: First, was this really bile that gushed in such a flood from the peritoneal cavity; and secondly, if so, how did it get there? We may be better able to answer these questions after consideration of the facts brought out concerning similar and cognate cases hitherto reported.

Cases have been considered eligible for listing in the appended table only when the gall-bladder, cystic and common ducts, stomach and duodenum have been satisfactorily examined at operation or autopsy or both.

Nauwerck and Luebke[1] as well as Sick and Fraenkel,[2] would go much farther and exclude all cases that had not come to autopsy and had the gall-bladder examined microscopically by serial sections. This seems to be an unreasonable requirement.

REACTION OF THE PERITONEUM TO EFFUSED BILE AND POSSIBILITY OF SPONTANEOUS CLOSURE OF PERFORATION

The reaction of the peritoneum to the presence of effused bile depends on whether the bile is sterile or infected. Infected bile, of course, causes a peritonitis virulent in proportion to the activity of the bacterial content. Sterile bile, on the other hand, is well tolerated. Experiments made in 1903 by Fraenkel and Krause[3] showed that "opening of the gall-bladder by means of laparotomy in guinea pigs and rabbits under aseptic precautions did not injure the health of the animals in the slightest degree. If one kills such an animal after some time, one is convinced that the unsutured wound has cicatrized with partial obliteration of the gall-bladder and with adhesions to the surrounding tissues."

Clinical cases are by no means lacking to show that bile even in enormous quantity may be well tolerated by the peritoneum and

[1] Loc. cit. in tabula.
[2] Beitr. z. klin. Chir., 1913, lxxxv, 687.
[3] Ztschr. f. Hygiene, xxxii.

Operator	Date, Sex and Age	Duration of Sympt.	Previous Icterus	Injury	Condition of Bile Tract	Nature of Effusion	Bacter. Exam.	Exam. at Operation	Examination at Autopsy	Examination of Specimens	Treatment	Result	Publication
(1) Clairmont and v. Haberer	2-6-10 Male 64	27 days	Yes	None	No perforation. Darkspot on common duct as of beginning gangrene. Calculus size of peachstone in common duct	7 or 8 litres of intensely yellow, odorless ascitic fluid	None at operation	Evidently thorough	No perforation of bile tract. Gram-positive cocci in pairs and short chains in peritoneal fluid. Two small stones in common duct. Mucous membrane of gall-bladder inflamed	None recorded except of liquid	Stone pushed into gall-bladder and extracted. Gall-bladder drained	Death	Mitt. a. d Grenzgeb. d Med. u Chir., 1910, xxii, 154
(2) Ritter and Schievelbein	1-14-10 Male 32	6 days	Not mentioned	None	Gall-bladder swollen, tightly distended, smooth, glistening, œdematous, greenish. Oozing from the gall-bladder is a hardly visible, clear, yellow liquid which stains gauze light yellow. Small stones in gall-bladder and cystic duct. Gall-bladder contained muddy grayish-green bile	Abundant, clear, serous strikingly yellow-colored liquid	Negative	Very thorough	No autopsy. Patient recovered	Gall-bladder showed no perforation. Wall much thickened	Cho ecystectomy. Common duct not drained	Recovery	Beitr. z klin. Chir., 1910, lxxi, 570
(3) Doberauer	7-22-00 Male 38	3days	None	Hit by a branch from a falling tree 3 days before	Gall-bladder thin, tightly filled. No concretion palpable. No lesion of cystic nor common duct	Entire abdominal cavity filled with bile ascites		Evidently very thorough			Tamponade and tube drainage to region of common duct. Dry mopping	Recovery	Mitt. a. d Grenzgeb. d Med. u Chir., 1911-12, xxiv, 305
(4) Doberauer	8-23-00 Male 16	3 weeks	None	None	Gall-bladder filled, smooth, thin — no stones. No stones in cystic nor common duct	Abdomen full of dark, viscid bile mixed with a little pus	Typhoid Bacilli in pure culture	Evidently very thorough			Dry mopping Cholecystotomy. Drainage	Recovery	Ibid.
(5) Johansson of Sabbatsberg	1-27-12 Female 76	1 day or 1 month	None	None	Gall-bladder thickened and containing 1 movable stone. No perforation. Gall-bladder contained green, viscid bile	The whole right side of the abdomen filled with green bile			No stone nor perforation of bile-ducts	Gall-bladder contained green bile and stone. Microscopic examination shows great inflammation	Cholecystectomy	Death	Hygeia Med. Och Farmaceut. Manadsskr., 1913, p. 393
(6) Favreul	8-15-12 Female 52		None	None	Gall-bladder enlarged and thickened. Mucosa thickened, but not ulcerated. No calculi, no perforation in gall-bladder or ducts. Common duct dilated	Liquid tinged with bile	None	Yes	Hard tumor in head of pancreas	No microscopical examination	Drain in pelvis	Death in 3 hours	Gaz. méd. de Nantes, 1913 xxxi, 161
(7) Brugnatelli of Pavia	9-20-12 Male 26	12 days	Yes	Riding a bicycle. Th'wn again't a carriage		4 litres in 2 aspirations of reddish bile liquid. Clear reaction of bile pigment demonstrated by accurate chemical examination			6 litres of liquid found at autopsy which had reaction of bile. Diffuse fibrinous peritonitis. All abdominal organs entirely or partly covered with fibrin. No trace of perforation of gall-bladder or any of the ducts. Gall-bladder distended by injection through		Aspiration of 4 litres of bile liquid. 2d aspiration (12 days later) of 1200 ccm. of same	Death	Policlin., Roma, 1913, xx, 544
(8) Wolff of Gelsenkirchen	1912	2 days	None		Widespread adhesions at the hilum of the liver and gall-bladder, and duodenum. Numerous stones in the gall-bladder. Gall-	Muddy, bile-colored purulent exudate in considerable quantity	None mentioned	Not very thorough	No perforation of gall-tract, stomach nor intestine. No ulceration anywhere nor suspicious point. Gall-blad	None mentioned	Irrigation of peritoneal cavity. Drainage of	Death from peritonitis	Berl. klin. Wchnschr., 1912, xlix, 2354

(8) Wolff of Gelsenkirchen	1912	2 days	None		Widespread adhesions at the hilum of the liver and gall-bladder, and duodenum. Numerous stones in the gall-bladder. Gall-bladder adherent, but unchanged in other respects	Muddy, bile-colored purulent exudate in considerable quantity	None mentioned	Not very thorough	No perforation of gall-tract, stomach nor intestine. No ulceration anywhere nor suspicious point. Gall-bladder macroscopically normal	None mentioned	Irrigation of peritoneal cavity. Drainage of gall-bladder	Death from peritonitis	Berl. klin. Wchnschr., 1912, xlix, 2354
(9) Guibe	2-12-13 Female 68	13 days	None	None	Gall-bladder full of bile under tension. No calculi	An abundance of extremely bilious liquid	None	Superficial	A great quantity of free bile, normal except for its thickness. No false membrane. No evidence of perforation of bile tract. Cancer of head of pancreas. Secondary cancer of liver. Nodule obstructing common duct		Drainage	Death	Rev. de Chir., 1914, xlix, 233
(10) Salager and Roques	3-22-13 32	2 days	None	None	Gall-bladder full of a liquid thicker than the effusion, but like it in other respects. Gall-bladder engorged and distended, but not perforated. Calculus in common duct size of olive pit	Saffron-yellow liquid in peritoneal cavity. Effusion colored green by picric acid, but not by any other substance. Pettenkofer's test negative	None	No operation	Gall-bladder and ducts intact		Patient died without operation	Death	Montpellier med., 1913, lvi, 67
(11) Madlener	Pub. 1913 63	2 days	Slight	None	No discoverable perforation. Gall-bladder inflamed. Bile tract covered with plastic adhesions. Stones in gall-bladder and common duct	½ to ¾ litres exquisitely bile-colored exudate	None	Apparently as careful as possible in a place covered with adhesions and plastic lymph	Patient recovered	None	Cholecystostomy and probably choledochotomy	Recovery	Beitr. z klin. Chir., 1913, lxxxiii, 620
(12) Henschen	7-17-14 64	1 day	None	None	Gall-bladder dark brown, tightly filled, not perforated. No stones nor perforation in the bile tracts	Entire upper abdomen filled with olive green muddy, not stringy bilious fluid, ¾ litre streams out	None mentioned	Yes	Mucous membrane of gall-bladder unchanged. Phlegmonous inflammation at junction of gall-bladder and cystic duct	Spot on neck of gall-bladder, covered with fibrin and wall destroyed with ulceration	Mikulicz drain	Death in a few hours	Cor.-Bl. f. schweiz. Aerzte, 1915, xlv, 503
(13) v. Kutscha	21		None		Acute cholecystitis						Cholecystectomy. Drainage of common duct	Recovery	Wien. klin., Wchnschr., 1912, Mar 15.
(14) Leriche and Cremieu (Lyons)	2-25-13 Female 35	2 days	Slight	None	Gall-bladder enormous, distended, rigid, full of calculi. Oozing of a true bile dew, or greenish rain coming out in droplets. No trace of perforation of gall-bladder or bile ducts	1½ litres clear bile liquid without pus. One would have said "an ascites strongly colored with bile"	None mentioned	Apparently very thorough		Gall-bladder wall 4 centimeters thick, greenish, œdematous	Cholecystectomy	Recovery	Lyon méd., 1913, cxx, 856
(15) Gibbon (Philadelphia)					Gall-bladder full of bile. No stone. Gall-bladder red and inflamed. Bile was seeping from gall-bladder wall. Ducts and duodenum examined	A lot of free bile in peritoneal cavity	None mentioned	Thorough			Cholecystostomy	Recovery	Ann. Surg., Phila., 1913, lviii, 430
(16) Nauwerck and Luebke (Chemnitz)	5-21-12 Male 56	7 days	Yes	None	Gall-bladder tightly distended with black, syrupy viscid bile. No opening in gall-bladder or ducts	Great quantities of bile in true pelvis and in rest of abdominal cavity	Effusion sterile; colon bacilli in bile of gall-bladder	Thorough	Common duct not obstructed. Water distention through a canula shows no leakage from bile tract. Membrane of gall-bladder dark brown to blackish green	Gall-bladder examined microscopically with serial sections. Minute defects at different layers found. No permeability with bristle	Aspiration of gall-bladder with suture and drainage of abdomen	Death	Berl. klin. Wchnschr., 1913, l, 624

that spontaneous closure of a traumatic lesion of the bile tract may occur after repeated tappings and be followed by recovery.

Mr. Fryer,[1] in 1813, reported the case of a boy of 13 who had received a violent blow over the liver by the shaft of a cart, on June 7, 1803. Eleven days later he was jaundiced and had acholic stools. Three weeks after the accident, he was tapped and *thirteen pints* of pure bile drawn off. On the thirty-third day he was again tapped and *fifteen pints* of bile withdrawn. On the forty-second day, 6 pints were removed. Complete recovery followed and he was known to be well 10 years later.

Mr. William Robert Barlow,[2] in 1844, reported the case of a man who had had a probable rupture of the common duct from lifting a heavy ladder. He developed a localized swelling in the right hypochondrium and was tapped at the end of 6 weeks and 7 quarts of pure bile drawn off. Thereafter, he was tapped successively on the fifty-fourth, sixty-fourth, seventy-third, eighty-first, and ninety-first days, the total amount of bile removed being 32 quarts, averaging more than 10 ounces a day for the whole period. No bile passed into the intestine during the entire 13 weeks. The man made a complete recovery in five months.

Bargellini[3] in 1897, reported the case of a young man who fell against a drinking fountain, striking on his hepatic region. He was ill for 20 days and then returned to his work. Three and a half months after the injury his abdomen was found to be full of liquid. He was tapped and ten litres of a dense liquid of an intense ochre-yellow color, almost exactly identical with bile, was removed. The patient recovered without further tapping.

On the other hand the rupture of the bile tract may not close and still the bile effused may for a long time be tolerated by the peritoneum.

Labrosse,[4] a pupil of Jaboulay of Lyons, in his inaugural thesis of 1912, reported the case of a young man of 17 years who, two years before, had fallen from a ladder onto a wall striking on the right hypochondrium. Eight or ten days later his abdomen began to enlarge and so continued till he came under Jaboulay's care. The abdomen was opened and there flowed out 8 to 10 litres of bile. A small perforation was found in the gall-bladder, which must have existed for two years, and the peritoneum was thickened and covered with false membrane. The patient died two months later of secondary infection through the drainage opening.

Very interesting in this connection is the case of Ratjen (abstracted by Sick and Fraenkel).[5]

The patient was a 15-year old boy, who had sustained no severe injury or external trauma. He had, however, a continually increasing effusion of bile into the peritoneal cavity as could be known by a constantly increasing circumference of the body, which necessitated repeated punctures. The patient finally recovered without open operation.

Nature of the effusion. An examination of the table will show that in not a single instance in which the abdomen was opened during life was a chemical examination of the liquid made to prove that it was bile.

During the operation it does not seem to have occurred to any of these surgeons that the effusion could be anything else than bile. In only one of the cases in the list was bile pigment demonstrated by chemical examination, that of Brugnatelli.[6] In this case aspiration of the liquid was twice practiced and the patient died. This case is not without suspicion of rupture, having been caused by injury and exhibiting at autopsy a fibrinous peritonitis. The report of the autopsy states that all the abdominal organs were entirely or partly covered with plastic lymph. Under these circumstances an unrecognized perforation might easily have existed.

The only other case in which a chemical examination of the effusion was made was that of Salager and Roques.[7] The patient died without operation, and an examination of a small quantity of the liquid by Pettenkoffer's test was negative.

If, therefore, a chemical examination of the effused liquid is made a condition for the acceptance of this pathological picture, then the whole case of a "bile peritonitis without perforation" falls to the ground.

On the other hand, it seems unlikely that such a considerable number of observers, many of them known to be skillful and experienced, should be mistaken in the recognition of a liquid so characteristic as bile.

This matter remains in doubt.

In two reported cases, those of Schievelbein[8] and Johannson[9], the authors found

[1] Med.-Chir. Soc. Tr., Lond., 1813, iv, 330.
[2] Med.-Chir. Soc. Tr., Lond., 1844, ix, 378.
[3] Riforma med., 1897, iii, 214.
[4] Contribution à l'etude du choleperitoine spontainé, Lyon: 1912.
[5] Ibid.
[6] Loc. cit. in tabula.
[7] Loc. cit. in tabula.
[8] Loc. cit. in tabula.
[9] Loc. cit. in tabula.

greenish bile in the gall-bladder and clear, yellow effusion in the abdomen; and strangely enough, this has been held to be a proof that the liquid was changed in color and consistence by filtering through the gall-bladder wall.

If some or all of these effusions are not bile, to what may their color be ascribed? The bilious hue of the ascitic fluid in jaundiced patients is a matter of common knowledge, and still this fluid is not bile. Mr. Thomas Skeete[1] pointed out this distinction in 1785, in the report of his case above noted.

Saffron-yellow peritoneal effusions are occasionally seen by all surgeons when necrotic tissue is present, such as a gangrenous gall-bladder or an appendix. These effusions have been subjected to chemical analysis by various surgeons and pathologists, notably by Davis,[2] of Philadelphia, and Roger and Derrien[3], who have found the color to be due to pigments derived from the blood. Askanazy,[4] of Geneva, also has evolved what he calls "the law of the pigmentophilie of necrotic tissue" which enables it to seize coloring matters and then to spread them.

Anyone who is disposed to be at all critical and to doubt the existence of a "bile peritonitis without perforation" can find reasonable grounds for disputing the case of Clairmont and von Haberer because of the general icterus; and the cases of Schievelbein,[5] Favreul,[6] Salager and Roques,[7] Madlener[8] and Leriche and Cremieu,[9] because of the presence of incipient or complete gangrene of the gall-bladder.

Condition of the bile tract. It is very interesting to notice that inflammatory or carcinomatous lesions or stones were present in 13 of the cases in the table, and of the other 3, 2 were cases following trauma and in 1, typhoid ulceration was probably present, the bacilli in pure culture being found in the effused liquid. Stone was present in 7 cases, obstruction of the common duct in 4 cases and cholecystitis in 10 cases.

In 81 per cent of these cases, therefore, there was undoubtedly a pathological condition of the gall-bladder or bile ducts and this, in itself, would to a certain extent support the observers in their assumption that the effused liquid was bile.

Bacteriological examination of the effusion. Bacteriological examination here is less important than chemical. It was made of the fluid found at autopsy in one case (Clairmont and von Haberer) cocci in pairs and short chains being found; of the fluid found at operation in one case (Doberauer), bacillus typhosus being in pure culture; it was negative in 2 cases (Schievelbein, Nauwerck and Luebke); in the other cases, no culture was made or the subject was not mentioned.

There are a number of possible channels for escape of the effusion into the peritoneal cavity:

1. *Filtration through the wall of the gall-bladder or bile ducts, rendered abnormal by disease or injury.* This theory, originally proposed by Clairmont and von Haberer, has received the support of 17 out of 19, who have reported cases or written at length on the subject. Schievelbein and also Askanazy summoned to the support of this theory the canals of Luschka, while Sven Johansson found in his case a great dilatation of the lymphatic vessels and considered this an element in the so-called filtration process.

No doubt the great majority of surgeons, if called on to express an opinion as to the likelihood of such a process, would be disposed, on general principles, to deny the probability of the filtration of bile through the unperforated wall of the gall-bladder or bile ducts, such a process being contrary to all experience in these or other hollow organs of the abdomen. They would consider that an undiscovered opening existed or that the liquid was not a true bile or bile mixture.

At the same time, there are a few cases which are very difficult to explain without accepting the filtration theory, namely, those of Gibbon,[10] Johannsson,[11] and Guibe.[12]

[1] Ibid.
[2] Ann. Surg., Phila., 1906, xliv, 718.
[3] Montpellier méd., 1913, lvi, 67.
[4] Berl. klin. Wchnshr., 1913, No. 36, 1645.
[5] Ibid.
[6] Loc. cit. in tabula.
[7] Ibid.
[8] Loc. cit. in tabula.
[9] Loc. cit. in tabula.
[10] Loc. cit. in tabula.
[11] Ibid.
[12] Loc. cit. in tabula.

2. *Microscopic perforation.* A perforation so small as to be detected only by the microscope and so devious in its course as to be found only by serial sections would seem to have very little claim to be the channel of escape for enough bile to fill the abdomen. Such, however, is the claim in the case of Nauwerck and Luebke. This theory of a devious, microscopic perforation is rendered less probable by the fact that the contents of the gall-bladder contained colon bacilli while the peritoneal bile effusion was sterile.

3. *Small perforation, hardly visible to the naked eye.* Sick and Fraenkel[1] in 1913, reported the case of a 32-year old man who, the day after a slight injury of doubtful import, had severe peritonitic symptoms. On the fourth day he was opened. The abdomen contained a great quantity of clear yellow bile. A small opening was found in the gall-bladder about as large as the puncture of an hypodermic needle. From this opening clear bile was exuding in little drops. Elsewhere, the bile tract was normal. The gall-bladder was excised and found to be normal, except for this opening which just sufficed for the passage of a bristle diagonally. This case, while not coming within the scope of the present inquiry, has a very decided bearing on another possible explanation for these cases, namely:

4. *Rupture subsequently healed,* leaving an unabsorbed effusion. This is a possibility which should not be overlooked; for such an occurrence has been frequently observed and a number of such cases are referred to in the earlier part of the present paper.

It should not be forgotten, however, that in these cases the opening is probably always closed by adhesions to other organs and especially to the omentum. This is the method of closure observed in experimental cases and is the normal way of cure in perforations of all the hollow organs of the abdomen.

In the cases under consideration and here tabulated, no such adhesions exist, which makes this explanation improbable, to say the least. Another possibility remains, namely, that the adhesions have subsequently pulled loose, which also is unlikely.

[1] Ibid.

5. *Rupture of an intrahepatic bile canal.* In 1905, Nauwerck[2] exhibited at the Medical Society of Chemnitz, the specimens of two patients jaundiced from stone obstruction of the common duct. Each of these specimens showed dilatation of the subserous bile canals on the surface of the liver and a rupture of one of these canals, in one case slit-like, and in the other almost as large as the head of a pin.

In 1909, Karillon,[3] one of Nauwerck's students reported 2 additional cases of the same nature. Nauwerck and Luebke in 1913 reported a fifth case with 1200 c. c. of almost pure bile in the peritoneal cavity with a subserous bile canal showing a rupture the size of the head of a pin.

In the same year, Vogel.[4] of Vienna, reported a similar case. Five additional cases have been reported, but in every one of these cases there was obstruction of the common duct by cancer or stone. In not one of them was the patient operated on, and the discovery of such a condition at operation is probably impossible.

As an explanation of two cases under consideration this condition is considered possible, but in the highest degree improbable.

6. *Postperitoneal rupture or perforation of the common or hepatic duct by trauma or ulceration,* followed by bile effusion into the postperitoneal tissue and subsequent rupture into the peritoneal cavity at a point more or less removed from the site of the perforated bile passage. This method for the escape of bile into the peritoneal cavity has not been suggested by previous writers on this subject.

Postperitoneal effusion of bile, from rupture or ulceration of the common or one of the hepatic ducts, is one of the rarely recorded pathological conditions. An early and very typical case of this kind is that of Mr. Thomas Wainwright,[5] of Dudley, England, reported in 1799.

The patient fell from his horse and received a violent blow in the epigastrium which caused profound shock and unconsciousness. The following day the epigastrium was swollen, tense, discolored and very tender. For several days the skin, con-

[2] Muenchen. med. Wchnschr., 1905, liii, 931.
[3] Inaugural Dissertation, Leipsig, 1909.
[4] Wien. klin. Wchnschr., 1913, xxvi, 1153.
[5] Med. and Phys. J., Lond., 1799, August.

junctivæ and urine were tinged with bile. The pain was constant and very acute and, after some time, extended gradually down the right side to the bottom of the belly and from thence to the left side; the abdomen was now tumid and an obscure fluctuation was felt. Eight weeks after the accident the patient died.

The *autopsy* was most interesting and evidently conducted with the greatest care. The bile had apparently escaped from a subserous rupture of the hepatic duct, where, for a space two inches in diameter, the peritoneum was lifted and formed part of the sac-wall. From its origin at the inferior surface of the liver, the sac was traced under the diaphragm; the fluid contained having dissected the pleura from the ribs, and formed a tumor which compressed the right lung; thence descending in the reverse course of the ascending colon, and pushing the caput coli obliquely inward, the sac passed into and completely filled the pelvis, pressing the urinary bladder into a very contracted space. Ascending from the pelvis, the sac followed the reverse course of the sigmoid flexure of the colon to the diaphragm, where it terminated. The right and left divisions of the sac communicated only in the pelvis, the spine forming a barrier between them. The sac held three or four gallons (by computation) of a grass-green colored fluid, which was evidently mixed largely with bile.

A plastic peritonitis was present, but no bile was found in the peritoneal cavity, notwithstanding the extensive subserous dissection, the long-standing of the condition and the tension of the enormous quantity of bile contained in the subserous sac.

That an undoubted postperitoneal rupture of some part of the bile tract may occur and elude a careful search for it at autopsy is shown by a case reported by Routier[1] in 1910.

In June, 1901, he performed a cholecystectomy for stone in the cystic duct and gall-bladder. The patient recovered and returned to her work. She later returned with a very deep, right-sided extraperitoneal abscess. This, Routier evacuated and drained. The next day bile began to drain from the tube and flowed in abundance till the patient's death, four days later.

He reports that "at the autopsy it was impossible for us to find the place from which the bile had escaped, which had filled the drained cavity. There had been an infiltration of bile all along the vertebral column; we discover the integrity of the cicatrix resulting from the former cholecystectomy; and we found a calculus with facets osbtructing the ampulla of Vater, and a small stone ramifying in the right branch of the hepatic duct. The common duct was a little dilated, but the rest of the intrahepatic bile tract appeared to be normal."

[1] Bull. Soc. de chir., de Par., 1910, xxxvi, 1311.

Interpretation of author's case. Returning to the questions propounded above concerning the author's case, it may be said that he is still convinced that the liquid effusion was a bile mixture, and that, taking all the facts into consideration, the most probable channel of its escape is the one last considered.

The history of previous attacks of cramp, in a young boy, always considered biliary colic; acute, almost gangrenous, cholecystitis and cholangitis as demonstrated at operation; history of an injury such as might cause a bursting rupture of a gall-tract; intense œdema of the ascending mesocolon and the postperitoneal cellular tissue; abundant bile effusion; prompt subsidence of all symptoms by free drainage of the bile tracts; taken together, seem to make a picture explained only on the hypothesis of a postperitoneal rupture of a bile tract, with secondary rupture into the peritoneal cavity.

TREATMENT

The conditions present in the recorded cases being so varied, no valuable conclusions can be drawn from the results of the different methods of treatment. It may be stated, however, that the gall-bladder was drained in 5 cases, with 3 recoveries and 2 deaths; the gall-bladder was removed in 4 cases, with 3 recoveries and 1 death; the hilum of the liver was tamponed in 3 cases, with 1 recovery and 2 deaths; the pelvis was drained in 2 cases, both fatal; aspiration was practiced in 1 fatal case and another patient died without operation. The general mortality, therefore, was 56 per cent.

Of the 14 cases operated on, in 6 the bile tract was drained with a mortality of 33⅓ per cent; in 8 the bile tract was not drained, and in them the mortality was 62.5 per cent.

Leaving out of consideration the results of the recorded cases, it would seem to be wise, when there is a peritoneal cavity flooded with bile from an undiscovered place of exit, to dry mop the cavity and drain the common duct, treating the gall-bladder as its condition requires. The chief indication is to prevent further effusion by tapping the great bile canal.

CONCLUSIONS

1. There is no typical disease picture to account for a bile peritonitis without evident perforation of the bile tract.

2. There is a group of recorded cases, with abundant effusion in which no perforation could be demonstrated at operation or autopsy.

3. These cases may be accounted for in a variety of ways, some fitting one hypothesis and some another, no one theory suiting all cases.

4. The bilious nature of the effusion still lacks the proof of a chemical examination. It is to be hoped that subsequent cases may be subjected to the test for bile acids and bile salts.

5. The cases being so unusual and so atypical, the diagnosis has not yet been made even tentatively, the real condition having never been even suspected in any of the published cases.

6. The treatment should be dry mopping of the peritoneal cavity and direct drainage of the common duct.

CLINICAL STUDY OF BLOOD PRESSURE AND HÆMOGLOBIN IN POST-OPERATIVE SHOCK; POSTOPERATIVE HÆMORRHAGE AND POSTOPERATIVE CARDIAC DILATATION[1]

By JOHN OSBORN POLAK, M.Sc., M.D., F.A.C.S., and OTTO H. HEFFTER, M.D., Brooklyn

OCCASIONALLY there is considerable difficulty in making the differential diagnosis between postoperative shock and concealed intra-abdominal hæmorrhage. The clinical picture in many cases is so identical that even the most experienced may err, unless proper recognition is given to the changes in the composition of the blood which take place in these two conditions, which may be shown in the hæmaglobin percentage and red and white cell count, together with the comparative blood-pressure readings.

At the Long Island College Hospital, during the past two years, we have been making a series of clinical observations upon the relation and clinical importance of blood-pressure, pulse pressure, hæmaglobin percentage, and leucocyte changes in post-operative shock and hæmorrhage, and in postoperative cardiac dilatation. The object of this study has been an attempt to correlate the value of laboratory findings as an aid in making a differential diagnosis in shock, hæmorrhage, and cardiac dilatation, the bedside diagnosis of which as I have said before, is often confusing or indeed even impossible.

A preliminary report of this work was offered before the section of Obstetrics and Gynecology of the New York Academy of Medicine, in November, 1916, by my Resident Gynecologist, Dr. Otto H. Heffter. In this preliminary report, the details of the procedure employed were carefully described. Our routine was as follows:

> Readings were taken on the day previous to operation. As soon as possible after operation a second reading was taken. Observations were repeated at convenient intervals for several days. Due to the fact that the work was carried on in conjunction with the routine ward work of the hospital, it was impossible to establish a definite schedule as to the time of making observations. Usually the first reading came within one hour following the operation, and several subsequent readings were made within the first 24 hours. Further readings came at daily intervals, or from 3 to 5 days. The blood-pressure readings were taken with the mercury column sphygmomanometer by the auscultatory method. The hæmoglobin estimations were made with the Sahli apparatus. The standard Leitz-Wetzler counting chamber and pipettes were used in making the blood counts. Blood smears were stained with Wright's polychrome solution.

Therefore, we will not take up your time in describing these details anew, save to say that the pulse pressure was taken in the great majority of instances, by the same man, and the reliability of the data can therefore be vouched for.

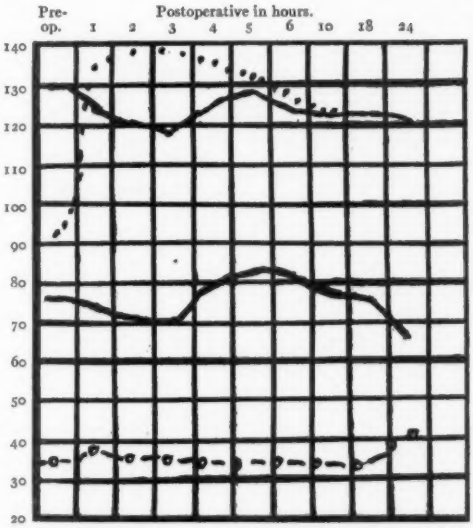
From this study we have found first, that

[1] Read before the American Gynecological Society, Pittsburgh, May 31–June 2, 1917.

the pre-operative index of the woman's cardiac strength is the pulse pressure. It makes no difference so far as the operative prognosis is concerned, whether the systolic blood pressure is 105 or 160, so long as the diastolic pressure is not within 30 millimeters of the systolic. In other words, provided the metabolism is near the normal, the pulse pressure of the individual is the index of cardiac strength, no matter what her systolic blood pressure may be. The only exception to this statement is the very high pulse pressure in aortic regurgitation. Second, the hæmaglobin and leucocyte count are the next important factors for pre-operative determination, and, third, the blood coagulation time of the individual is of considerable significance as a pre-operative consideration.

These observations together with a knowledge of the efficiency of the kidneys, as shown by the usual functional tests, are made as a pre-operative routine. Their routine employment will give the woman her greatest margin of safety, and afford the surgeon a basis for his differential diagnosis in post-operative conditions. With these factors definitely known, it is an easy matter, in any given case, to follow the postoperative course for the first 24 or 48 hours, and by the further aid of the laboratory, to be able to make a strong presumptive diagnosis as to the complicating postoperative condition.

In this study, we will consider first, what normally happens after an abdominal section with 50 to 80 minutes ether anæsthesia. In this series of cases ether anæsthesia, by the open or closed method, with preliminary morphine and atropine, was employed. The average length of anæsthesia was 75 minutes. The average amount used 5 ounces. It was found that there was a rise of 5 to 15 points in the hæmoglobin reading as taken from peripheral blood in 80 per cent of the cases studied, which rise was directly proportionate to the length of anæsthesia and the amount of anæsthetic used. In 12 per cent of the cases, the hæmoglobin reading remained unchanged. In one-half of these cases, however, the length of the narcosis was considerably below the average for the series. The remaining 8 per cent showed a drop in the reading. These



——Blood pressure. ....Pulse. —o—o—Hæmoglobin.

Chart 1. Clinical shock, with laboratory findings undisturbed.

were cases of hysterectomy in which there was considerable blood loss.

Four cases remained unchanged with no apparent explanation. In endeavoring to account for the rise in hæmoglobin, erythrocyte counts were taken with the readings. These remained fairly constant with only a variation, ranging from one hundred to two hundred thousand cells, which, we feel, is within the range of error. It was found that in 6 to 48 hours, the hæmoglobin reading had practically returned to what it was previous to operation.

Routine blood pressures taken one hour after the operation showed an average systolic drop of 14.2 millimeters of mercury. The diastolic pressure showed an average fall of 7 millimeters.

In the majority of cases the blood pressure returned to normal in 4 to 24 hours following operation. Those cases which were distinctly shocked returned to normal on the second or third day postoperative.

The leucocyte count showed a rapid rise, which was first noted one hour after operation, and increased in six to twelve hours. The average rise by the sixth hour was 10,150 cells. Differential leucocyte counts gave a

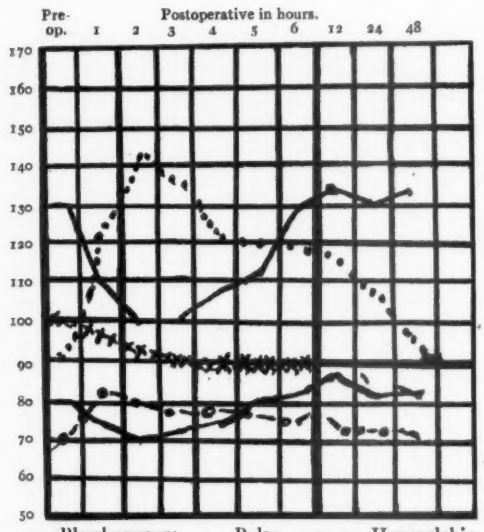


Chart 2. Typical example of laboratory findings in shock.

relative increase of the polymorphonuclear cells, their average rise being 14 per cent. The lymphocytes were accordingly reduced, while transitional cells remained unchanged.

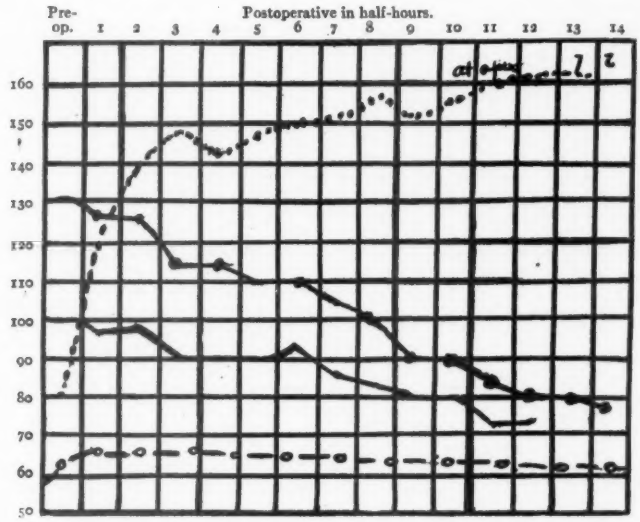
Now after establishing what occurred as normal phenomena following operation, we considered the changes in a series of cases in which the patients were clinically shocked, presenting the typical clinical picture of shock, with the pinched pale face, cyanotic lips, shrunken eyes, lusterless cornea, dilated pupils reacting poorly to light, cold and clammy extermities, cyanosis of toes and finger tips diminished reflexes, the general skin surface cold and clammy, and bathed in a cold sweat. The respirations were superficial, shallow and irregular, the temperature normal, or subnormal, the pulse was weak, rapid, and occasionally very slow, with a marked drop in the systolic pressure. Yet, with the patient presenting such a picture, the laboratory findings were negligible. Illustrative of this type, is a case of carcinoma of the cervix, in which a panhysterectomy was done.

The patient went on the operating table with detailed pre-operative laboratory findings. Her pulse-pressure was 50, and the hæmoglobin was 35 per cent. The blood showed agglutination and hæmolysis, in the donor. The red-cell count was 1,200,000: leucocytes, 9,000; and the coagulation time, 8 minutes. This patient was subjected to an operation, lasting an hour and a quarter, the greatest care being taken to avoid further loss of blood. She came off the table with a pulse of 130, small and compressible, and with all the clinical symptoms of shock, yet the laboratory picture showed that not only throughout the operation, but during the first 24 hours after, the pulse pressure was continuously maintained at 50 millimeters, and the hæmoglobin showed no variation. Furthermore, the red and white cell counts were not disturbed.

Another patient also suffering from malignant disease of the cervix, was subjected to a radical operation, which occupied nearly two hours. She was returned to her bed with a pulse of 158 and all the clinical signs of shock, but not withstanding, the laboratory picture showed her to have kept a constant pulse pressure of 50 throughout the first 24 hours of postoperative observation. The hæmaglobin, leucocyte, or red cell count in this case did not change from the readings of the pre-operative records.

In the second group of cases, while the patients presented the clinical phenomena of shock, we had also a definite laboratory picture, which differed so much from that found in the first group, that had we not made a very careful and detailed study of these cases, we would have conceded that the laboratory findings made the diagnosis. These cases showed a diminution in the systolic and pulse pressures, with a rise in the hæmoglobin and red cell count. In illustration of this class, another case may be cited.

A woman of small type, had a series of plastics, with removal of the upper segment of the uterus, following the Bell-Buettner technique. This patient had the usual full pre-operative records. The red cell count was 4,200,000; the hæmoglobin 75, the leucocytes 8,200, with a blood pressure of 130 over 80. Following the operation, we found that the hæmaglobin had risen to 85, and the red cells to 5,000,000 remaining high for the first 24 hours, not reaching normal until the afternoon of the day following operation. The leucocytes dropped to 6,000. The blood pressure showed a drop of from 130 to 100 systolic over 70 diastolic. In other words, the pulse pressure dropped from 50 to 30 as a result of the operation. This patient was given oxygen inhalations upon the withdrawal of the anæsthetic, and reaction occurred 35 minutes later. With the reaction we noted an immediate rise in the blood pressure to 125 over 75. After the oxygen was



———Blood pressure. .....Pulse. —o—o—Hæmoglobin.

Chart 3. Hæmorrhage, with no variation in hæmoglobin.

stopped the pressure again dropped to 110 over 78, and it was not until 48 hours after the operation that the normal ratio of 130 over 80 was re-established.

In our third group of cases, we were dealing with shock and hæmorrhage and we had supposed that with the aid of the hæmoglobin estimation, and repeated blood pressure readings, we would be able to differentiate positively between shock and hæmorrhage. We were, however, doomed to disappointment, as clinical experience shows that unless the hæmorrhage has been a frank hæmorrhage, the hæmoglobin estimation and the red cell count show little change; hence have little or no significance in determining the presence of slow bleeding. However, the pulse pressure and an increasing leucocytosis will give valuable information. We know that in ectopic, immediately following the rupture, we have a drop in the hæmaglobin, a drop in the systolic and pulse pressure, and an increase in the leucocyte count. This, however, is not true where slow bleeding takes place after operation. As you will see in the accompanying chart the hæmaglobin percentage may not change even when bleeding is continuous. This patient had a pulse pressure of only 10, yet the hæmoglobin remained 65 per cent.

Clinically, but two facts stand out in the differentiation between shock and hæmorrhage: (1) in hæmorrhage the pulse rate is always progressively increased; (2) the leucocyte count is also increased.

The striking similarity in the clinical manifestations of these two conditions is due to the fact that in hæmorrhage the blood is permanently lost from the vessels, while in shock it is accumulated in the large venous trunks of the splanchnic plexus, and, therefore, is of as little use in maintaining the blood pressure as if the volume of blood was actually outside the body. This, according to Crile, is due to the exhaustion of the vasomotor center, the cardiac and respiratory failures being secondary to the exhaustion of the vasomotor control. While Porter, Mann, Gatch, and others accept the peripheral theory of shock, it matters not with which side one aligns himself, two facts must be accepted; first, that the visceral and peripheral arterioles are constricted, and second, that the veins and venous channels in the splanchnic area are dilated and contain the body fluid. In hæmorrhage, if it be of any con-

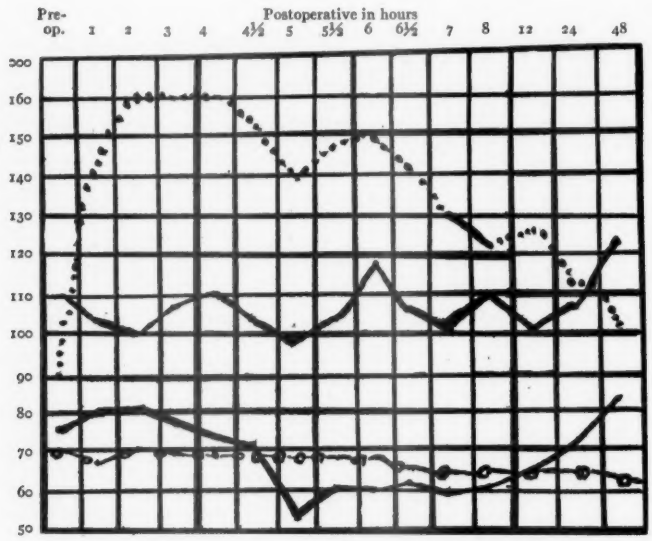
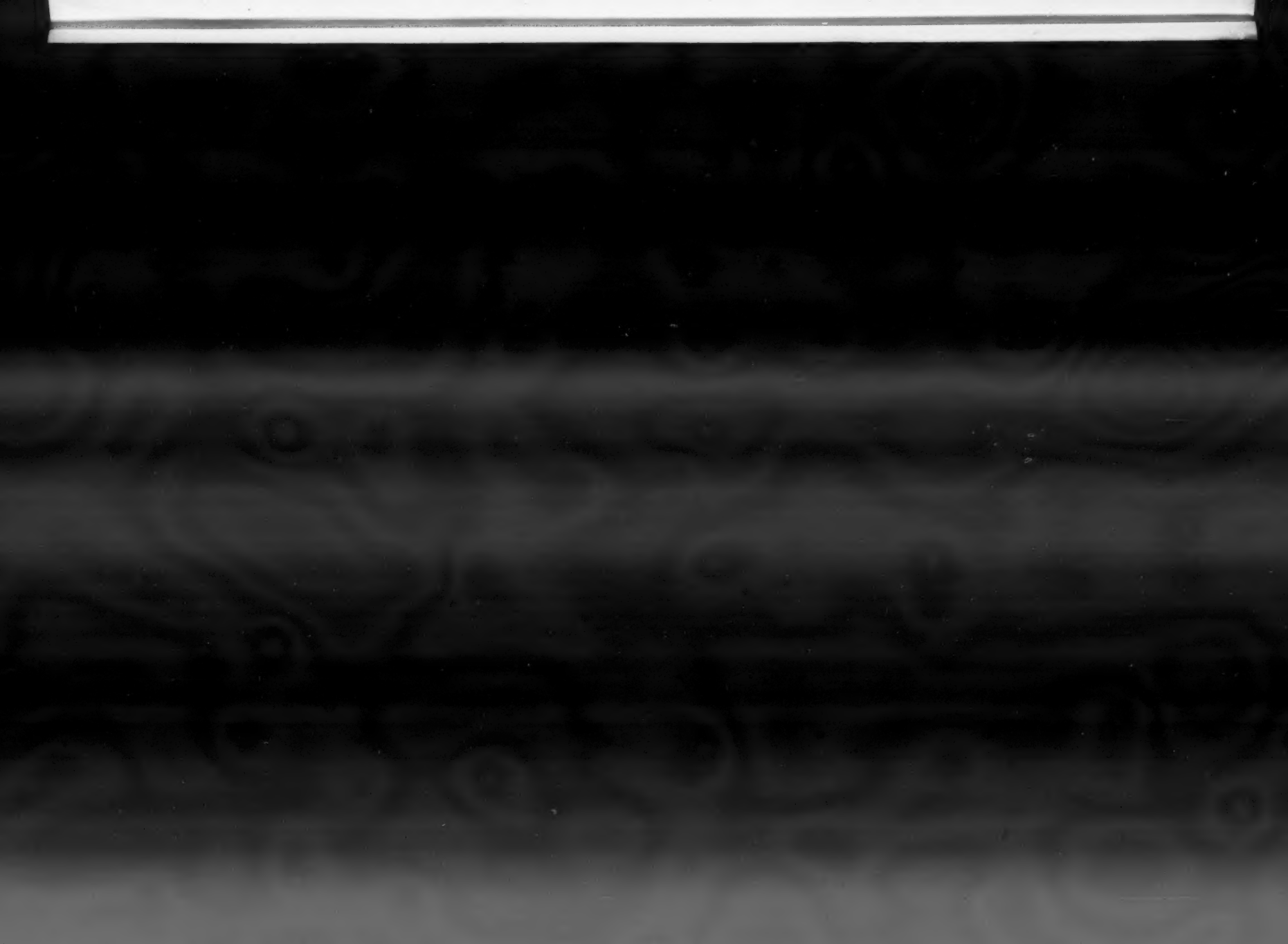


Chart 4. Cardiac dilatation. Strophanthin given four and a half hours postoperative.

siderable quantity, one may always expect to find, first, a fall in the number of red cells per cubic millimeter; second, a decrease in the percentage of hæmoglobin; and third, an increase in the number of white cells, with the maximum increase occurring early. In shock, on the other hand, the diminution in the red cell count does not occur, but there is usually a reduction in the leucocyte count. When the bleeding occurs in the abdominal cavity, which is the most frequent site of internal concealed hæmorrhage in women, the two conditions vary only in the fact that in one (hæmorrhage), the blood is outside the vessels, and in the other (shock) it is inside. In shock there is always a loss of the circulatory fluid due to the large quantity of blood which is cut out of the general circulation, by the dilatation of the venous channels of the splanchnic plexus. The splanchnic vessels alone, as is well known, are capable of holding several times the total amount of blood in the body. In health there are two factors which prevent the filling of these vessels: first, the vasomotor apparatus; second, the contraction of the abdominal muscles. The first acts by decreasing the amount of flow into the splanchnic area, while the contraction of the abdominal muscles raises the intra-abdominal pressure and diminishes the capacity of the capillary and venous channels.

The flow through these vessels, therefore, depends upon the *vis a tergo of the heart* assisted somewhat by the *negative pressure in the thorax*, and by the *rhythymic variations in the intra-abdominal pressure*, resulting from the contraction of the abdominal muscles.

Paralysis of the abdominal walls or laparotomy must reduce the intra-abdominal pressure to that of the atmosphere and while the heart continues to fill these vessels, there is no force to drive the blood out of them. Their capacity is greater than the entire volume of blood in the body and their walls have no external support. Hence the splanchnic vessels will become immensely distended and consequently the peripheral blood pressure will drop. This explains the value of posture and sand-bag pressure on the abdomen in postoperative shock. Experiments on animals show that life is possible when intra-abdominal pressure has been reduced to that of the atmosphere *only* when the *return of blood* to the heart is assisted by gravity *and*



when the animal is not required to make any great exertion. In the human, abdominal incision causes a sharp decrease in abdominal pressure. Small incisions, short anæsthesia, and non-eventration of the viscera minimize the splanchnic paralysis, while large incisions, protrusion, and exposure of intestines are supposed to allow a marked stasis of blood to take place in the abdominal veins. This withdraws a dangerously large amount of fluid from the circulation; hence, shock is increased. Gatch has demonstrated that the deeper the anæsthesia, the greater the accumulation of blood in the abdomen and legs, consequently the blood pressure must be lowered. This is why operations in the Trendelenberg posture under light anæsthesia have less shock. When actual blood loss, as occurs in hæmorrhage, is added to this intra-abdominal stasis, the loss in pulse pressure must be greater.

Pulse-pressure readings taken during the operation have shown that traction on the mesenteries and exposure of the intestine to air, increases the pulse rate and lowers the pressure. For exposure causes the intestine to become congested and blue in color, and after prolonged handling it becomes œdematous and subperitoneal extravasation of blood occurs and the pulse is accelerated, and the pulse pressure falls. The blood pressure falls because there is not enough fluid in circulation to maintain it. Morphinization at this time changes this picture. In cardiac dilatation our studies show but one constant laboratory finding, namely, lowered pulse pressure. The clinical picture is unmistakable and needs no description before such an audience as this.

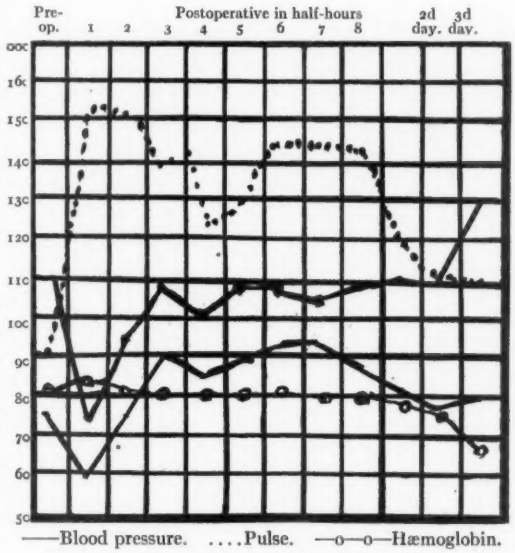


Chart 5. Shock with operative hæmorrhage. One ampoule of strophanthin given intravenously four and one-half hours postoperative.

CONCLUSION

The deductions which one may draw from these studies are:

1. There is a constant rise of 5 to 15 points in the hæmaglobin readings following anæsthesia with ether, when such anæsthesia occupies more than 30 minutes. Consequently, allowance must be made for this rise in using hæmaglobin estimations as a diagnostic sign in internal bleeding.

2. The erythocyte count is also increased but its variation from the pre-operative is so slight that it does not warrant any conclusions.

3. In the majority of cases there is a moderate fall in both the systolic and diastolic blood pressure following ether anæsthesia. The blood pressure returns to normal, that is to the pre-operative reading, in 12 to 48 hours. The inhalation of oxygen after the withdrawal of the ether vapor diminishes this fall in blood pressure but is only transient in its effect.

4. In cases of shock, especially where there has been much blood loss during the operation, the fall in blood pressure is greater than after long operation without blood loss, dropping from 10 to 50 millimeters.

5. The pulse pressure is a better index of hæmorrhage or cardiac failure than the systolic pressure.

6. There is a constant rise in the leucocyte count in hæmorrhage, while the leucocytes fall in shock.

My thanks are extended to my resident, Otto H. Heffter, and my internes Doctors Shutter and Curry, for their painstaking work in making the laboratory findings in this series so complete as to allow us to draw these deductions.

CLINICAL AND EXPERIMENTAL STUDIES ON CONGENITAL PYLORIC STENOSIS[1]

By RICHARD LEWISOHN, M.D., F.A.C.S., New York
Attending Surgeon, Beth Israel Hospital and Montefiore Home; Associate Attending Surgeon, Mount Sinai Hospital

STENOSIS of the pylorus in newborn babies is a borderline disease and its successful treatment needs the closest co-operation of the pediatrist and the surgeon. Some pediatrists have claimed that in the vast majority of cases the disease can be cured without surgical interference. On the other hand, surgeons have made the statement that congenital pyloric stenosis is a purely surgical condition, that medical treatment of these cases is not only without any value, but decidedly harmful. Both these statements are erroneous.

The attempt has been made to divide this disease into two distinct groups: (1) pylorospasm and (2), true hypertrophic pyloric stenosis. The opinion has been expressed frequently that the first group requires only medical treatment, whereas the second group requires surgical intervention. Such a division of these cases into two groups is too didactic. Holt's advice, simply to divide these cases into mild and severe cases without making an actual anatomical distinction between the two groups, is more in accordance with the clinical facts.

The cause of this disease is a malformation at birth with secondary œdema; in fact, Dent has observed a true pyloric stenosis in a seven-months' old fœtus which shows that the origin of the disease dates back to the antenatal period.

The clinical symptoms of congenital pyloric stenosis are: incessant vomiting, loss of weight and constipation, palpable tumor and visible peristalsis. In a case presenting the above signs the presence of a pyloric tumor is pathognomonic of the disease. However, in many cases the pyloric tumor is not palpable. Visible peristalsis of the stomach, loss of weight, and vomiting are sufficient clinical signs to establish the diagnosis.

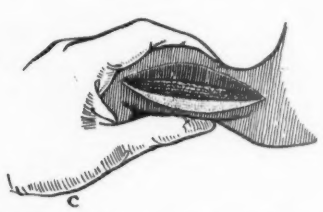


Fig. 1. Rammstedt operation (copied from Sloan).

We do not agree with the opinion expressed by some that all patients with congenital pyloric stenosis, should be immediately operated upon. The pediatrist should try to cure these cases with proper diet, paregoric, and other remedies. If all his endeavors are futile, if no improvement is observed after a few days, and if the baby continues to lose weight rapidly, the case should be treated surgically without much delay.

Seventeen cases of congenital pyloric stenosis were admitted to Dr. Koplik's Service at Mount Sinai Hospital during the last three years. Eight cases were treated medically, and nine were transferred to the Surgical Department. Of the former eight cases, one died and seven were discharged from the hospital as improved or cured. The mortality among the nine cases operated on was much higher; five were cured and four died. The fact that the severe cases with marked emaciation were subjected to operation, whereas the milder forms of this disease were treated medically, may explain the much higher mortality among the cases operated on.

Methods of operation. Until a few years ago gastro-enterostomy represented the only surgical procedure for these cases. Since then, the Rammstedt operation, published in 1913, has acquired great popularity. This operation consists of incising in a longitudinal direction the thickened and hardened pylorus through serosa and muscularis and down to the mucosa, without perforating the mucosa (Fig. 1). The division of the contracted muscular ring effects a re-establishment of the pyloric

[1] From the Laboratory for Surgical Research, College of Physicians and Surgeons, and the Surgical Service of Dr. A. A. Berg, Mount Sinai Hospital.

lumen and a disappearance of the obstructive symptoms.

This new and very ingenious operation was generally adopted and extensively used by surgeons. Downes, for instance, has reported sixty-six cases of pyloric stenosis operated on, thirty-five of which were operated on by the Rammstedt method. The mortality of his cases was 23 per cent. Gallie and Robertson have lately reported sixteen cases of Rammstedt operation with a mortality of 31 per cent.

Whether this Rammstedt operation will entirely supplant gastro-enterostomy in the surgical treatment of congenital pyloric stenosis remains to be seen. The operation, though it appears very simple and harmless, is certainly not without danger. In order to effect a cure the thickened pylorus must be divided in its whole length and thickness. If the incision fails to divide the entire thickened area from stomach to duodenum, if it is just a little too short, a cure will not be effected. If this incision is made only 1 millimeter too long on the duodenal side, there is grave danger of opening the duodenum, which is especially thin in these cases. In other words, the margin between what we must do to accomplish our object and what we must avoid to prevent serious damage, is such a narrow one that the operation cannot be regarded as free of risk or danger.

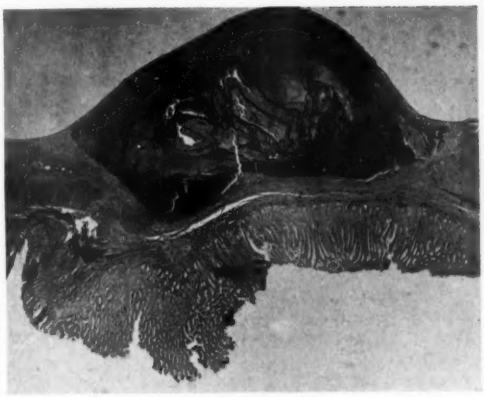


Fig. 2. Rammstedt operation upon dog, thirteen days after operation.

Experiments. The series of experiments upon dogs was performed in order to study the histological effects of the Rammstedt operation. Six specimens were examined microscopically. A period ranging between five and ninety-one days had elapsed between the time of operation and the time of autopsy.

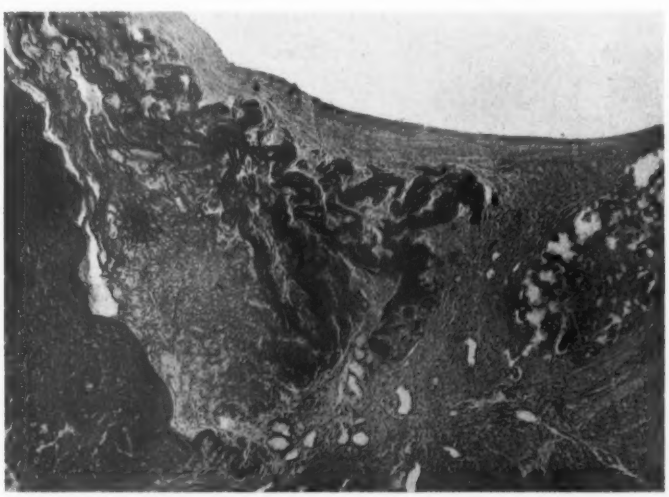


Fig. 3. Same as Figure 2, higher magnification.

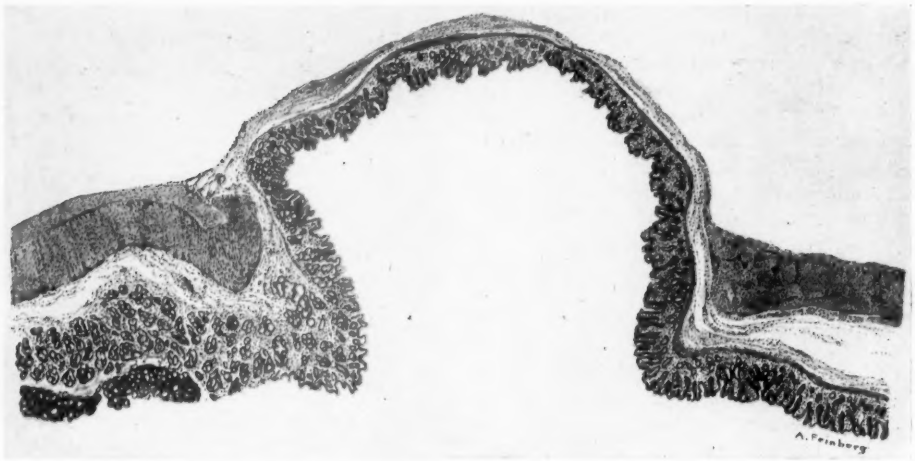


Fig. 4. Hernia of the mucous membrane, following an experimental Rammstedt operation.

Dog 280, Surgical Pathology No. 3,414. Operation, April 6, 1915. One and one-half inch longitudinal incision. Died, April 11, 1915 (peritonitis). Autopsy revealed the following: The mucosa exposed by the Rammstedt operation was gangrenous; there was no perforation. Diagnosis: gangrene of stomach mucosa, peritonitis. Microscopical examination: The cut ends of the muscle-bundles are separated from one another by a distance of 12 millimeters. The intervening space is filled with a dense blood coagulum. There are a few leucocytes, indicating the absence of infection at this point. Very little repair has taken place. At the junction of the muscularis with the blood-clot, areas of dead tissue are visible. The submucosa and mucosa are intact throughout.

Dog 359, Surgical Pathology No. 3,516. Operation, May 18, 1915: 3 centimeter longitudinal incision; four black localizing sutures. Killed, May 31, 1915. Autopsy revealed the following: The place of incision was prominent, showing a reddish protruding area, extending up to the four localizing sutures. Microscopical examination: There is a defect in the wall of the pylorus, 11 millimeters in width, extending down to the submucosa. This defect is filled with a very dense mass of fibrin with particularly thick strands. It projects as a nodule above the adjacent serosa. The repair is represented by a growth of fibroblasts in a thin film over the surface of this mass. Apparently no growth has occurred into the mass itself. A cross section of the black silk suture just beneath the serous surface at the edge of the mass shows wide separation of the fibers by connective tissue. The mucous membrane and submucosa are intact throughout (Figs. 2 and 3).

Dog 166, Surgical Pathology No. 3,311. Operation, January 19, 1915: Longitudinal incision and small cross incision. Killed, February 9, 1915. Autopsy revealed the operative field covered by adherent omentum; region of incision somewhat hardened. Microscopical examination: Cross section through the pylorus at the region of the incision; mucous membrane and submucosa are intact throughout. The inner circular layer of the muscularis appears intact. The outer layer of the muscle has almost completely disappeared and at this point the fatty vascular tissue of the omentum is attached. The omentum is also adherent to the serosa throughout the length of the section.

Dog 335, Surgical Pathology No. 3,532. Operation, May 4, 1915: typical Rammstedt operation. Killed June 8, 1915. Autopsy revealed a slight scar, 5 centimeters long in pyloric region, of whitish color. Microscopical examination: Mucosa and submucosa are intact and normal throughout. There is a complete gap in the muscularis ½ centimeter in width, filled with omentum and scar tissue, which is attached directly to the submucosa.

Dog 180, Surgical Pathology No. 3,396. Operation, February 2, 1915: 3 centimeter longitudinal incision over the pyloric region; mucosa accidentally perforated; it was closed with purse-string suture. Killed, March 30, 1915. Autopsy revealed a whitish scar, partly covered by small omental adhesion. Microscopical examination: The mucosa is intact throughout, but at the site of the incision, it is somewhat irregular and some of the glands are cystic. There is a small irregular band of scar tissue dividing both muscular layers, about 1 millimeter in width. The omentum is adherent to the external border of the scar tissue.

Dog 270, Surgical Pathology No. 3,561. Operation, March 30, 1915: Rammstedt operation. Killed, June 29, 1915. Autopsy revealed a distinct defect about the size of a pea at place of operation

Fig. 5. Case 4, baby two weeks after Rammstedt operation.

Fig. 6. Same baby, nine months later.

with hernia of the mucous membrane. Microscopical examination: There is a complete gap in the wall of the pylorus about 1 centimeter in width; projecting through this is a fold of the mucosa, which is covered throughout with fibrous submucosa. The cut ends of the muscularis are attached to the submucosa at either side of the defect (Fig. 4).

The findings can be summarized in the following manner: Following an incision of the pylorus through serosa and muscularis, there is evidently a gaping wound produced, which fills with blood-clot, to which the omentum becomes adherent. This clot is replaced by fibrous tissue, which, when it contracts, brings the cut muscle ends into such close apposition that they may only be separated by millimeters. Regeneration of the smooth muscles does not seem to occur.

Of peculiar interest is the case in which there was an eversion of the mucosa and submucosa through the defect. As no mention of a similar occurrence can be found in the literature, reasons for its occurrence are only problematical. It is possible, however, that it may have occurred very shortly after the operation was completed, due to a violent segmentation-contraction of the pyloric musculature, which may have forced a fold of mucosa and submucosa through the gaping wound. Fibrinous adhesions may then have fixed the raw submucosa to adjacent omentum (Fig. 4).

Case 8 of the series shown in chart is of sufficient interest to warrant a more detailed description. This baby was brought to the hospital with typical symptoms of pyloric stenosis. A Rammstedt operation failed to stop the vomiting. Therefore, a second laparotomy was performed eighteen days after the primary operation. In the attempt to lengthen the original incision across the pylorus the duodenum was accidentally injured. The pinhole opening in the duodenal mucosa was closed with a double purse-string suture.[1] These sutures narrowed the lumen of the duodenum to such an extent that a gastroenterostomy was deemed necessary. The child died two days following the second operation.

A postmortem examination was performed and the stomach removed *in toto*. The specimen showed very well why the vomiting had not stopped after the first operation. The Rammstedt incision, though of sufficient length, had not divided the musculature completely, except in the very center of the incision (Fig. 7, *a*), where the mucosa was distinctly

[1] The same accident happened to me in a case operated upon in a private sanatorium and not included in the accompanying chart.

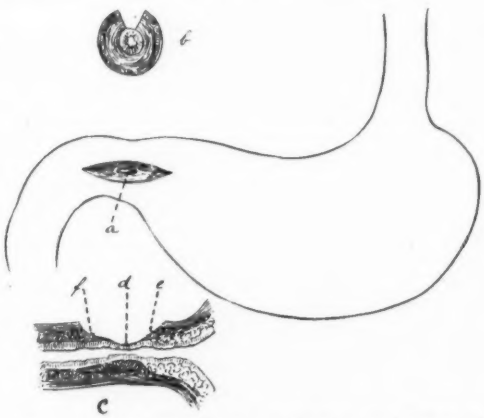


Fig. 7. Postmortem findings of Case 8. *a*, Mucosa of stomach exposed in center of Rammstedt incision; *b*, cross section through center of Rammstedt incision; *c*, longitudinal incision through pyloric region.

CASES OF PYLORIC STENOSIS OPERATED ON

Case	Date	Age	Duration of Symptoms	Operation*	Weight		Stay in Hospital	Result
					On Admission	On Discharge		
1	Dec. 1913	4 months	Since shortly after birth	Rammstedt	6 lbs. 1 oz.	8 lbs. 3 oz.	6 weeks	Cured.
2	Aug. 1914	3 months	2½ months	Rammstedt (Figs. 5 and 6)	5 lbs. 9 oz.	8 lbs. 2 oz.	2 months	Cured.
3	Aug. 1914	3 months	1 month	Rammstedt (accidental opening of duodenum)	8 lbs. 14 oz.	8 lbs.	40 days	Died of marasmus; signs of stenosis persisted; no postmortem.
4	Aug. 1915	4 weeks	Shortly after birth	Gastro-enterostomy			26 days	Continuous vomiting. Exitus. Postmortem showed ulcerative process in the whole gastro-intestinal tract. Gastro-enterostomy functionating.
5	Sept. 1915	6 weeks	3 weeks	Rammstedt	5 lbs. 8 oz.	5 lbs. 13 oz.	20 days	Cured.
6	Mar. 1916	6 weeks	2 weeks	Rammstedt	6 lbs. 4 oz.	6 lbs. 14 oz.	38 days	Cured.
7	Mar. 1916	7 weeks	3 weeks	Rammstedt	6 lbs. 15 oz.	6 lbs. 12 oz.	26 days	Died. No postmortem.
8	Nov. 1916	6 weeks	3 weeks	Rammstedt; second operation 18 days after first operation: revision of Rammstedt, accidental injury of duodenum, gastro-enterostomy (see Fig. 7).				Died 22 days after first operation, 2 days after second operation.
9	Mar. 1917	4 weeks	3 weeks	Gastro-enterostomy	5 lbs. 8 oz.	6 lbs. 9 oz.	28 days	Cured.

*Operators: Drs. Lilienthal, Berg, Moschcowitz, and Lewisohn.

visible. Figure 7, *b* shows schematically a cross section through this very center. Figure 7, *c* represents a longitudinal section through the pylorus beyond the edges of the incision. It shows that the muscular layer was incompletely divided, the incision having been carried down to the mucosa in one-third of its length only.

Microscopical studies of sections removed from the center of the incision, the proximal and the distal ends respectively were in accord with the macroscopical findings. The latter two sections showed the incomplete division of the muscular layers of the stomach.

a. Cross section through center of incision. A cross section through the middle of the gaping wound in the pylorus showed that both muscle layers have been completely divided and their ends have retracted leaving a V-shaped gap. The exposed submucosa is covered with a thin layer of fibrin which extends on either side and covers the cut muscle ends. Active proliferation of fibroblasts has replaced a portion of this fibrin meshwork. There is very moderate inflammatory reaction, evidenced by the presence of a few round cells. The mucous membrane is intact (Fig. 8).

b. Cross section through proximal end of incision. Sections of the cardiac end of the wound show a similar picture, except that the inner circular layer of muscle has not been completely divided and the fibrin meshwork at the bottom of the wound lies upon it instead of upon the submucosa (Fig. 9).

c. Cross section through distal end of incision (Fig. 10). Cross section through the duodenal end of the wound shows that the muscularis is almost intact, only a small defect being present in the outer layers, the surface of which is covered with a coagulum, among the fibers of which many young connective-tissue cells can be seen.

These sections demonstrate very plainly the incomplete division of the muscularis. In order to avoid the danger of perforation, the incision had not been uniform in depth and the stenosis was thus not completely relieved.

The seeming simplicity of the technique of the Rammstedt operation is apt to appeal to every surgeon. However, as stated above, the Rammstedt operation is not as simple and safe a procedure as has been claimed by Rammstedt and others. In three out of eight cases of our series the duodenum was accidentally opened by three different surgeons. Such a repetition of the same serious accident is apt to create scepticism as to the

Fig. 8. Cross section through center of incision (Fig. 7, *d*).

Fig. 9. Cross section through proximal end of incision (Fig. 7, *e*).

merits of this operation. The number of our cases is too small to warrant any definite conclusion.

The operative mortality of 13 per cent among thirty-six gastro-enterostomized cases (combined statistics of Scudder, Stillman and Richter) compares favorably with Downes' mortality of 23 per cent, following the Rammstedt operation. It will require a much greater series of cases than heretofore published before it can be definitely decided whether the Rammstedt operation can really be considered as the method of choice or whether gastro enterostomy, though less rapid

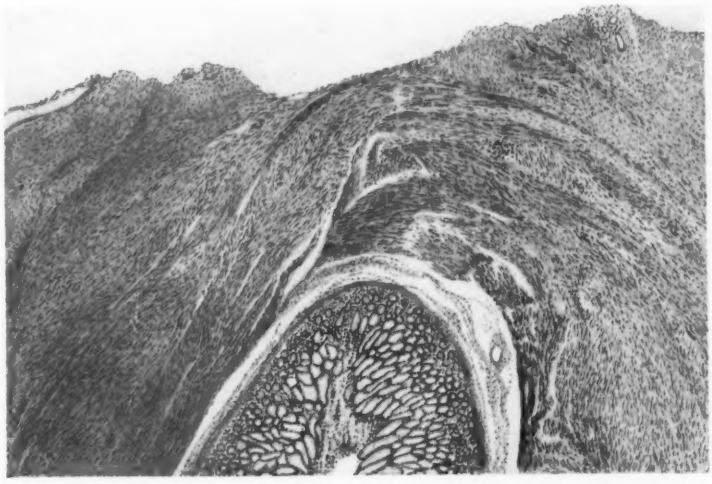


Fig. 10. Cross section through distal end of incision (Fig. 7, *f*).

in its execution, might not give better clinical results.

I wish to thank Dr. A. P. Stout for his kind help in the preparation of the histological reports.

LITERATURE

DOWNES. Operative treatment of pyloric obstructions in infants. Surg., Gynec. & Obst., 1916, xxii, 251.

GALLIE and ROBERTSON. Pyloric stenosis in infants. Canadian M. Ass. J., 1917, vii, 1.

HOLT. Medical versus surgical treatment of pyloric stenosis in infancy. J. Am. M. Ass., 1914, lxii, 2014.

RAMMSTEDT. Die Operation der angeborenen Pylorusstenose. Zentralbl. f. Chir., 1913, xl, 3.

SCUDDER. Stenosis of the pylorus in infancy. Ann. Surg., Phila., 1914, lix, 239.

SLOAN. Pyloric stenosis in infancy. Cleveland M. J., 1916, xv, 761.

FASCIA TRANSPLANTATION INTO LATERAL DEFECTS OF THE MAJOR ARTERIES

BY HAROLD NEUHOF, M.D., NEW YORK

From the Department of Surgery, Columbia University, College of Physicians and Surgeons.

As a result of many investigations, the great advantage of auto- over homo- and heterotransplantation of tissues for the replacement of total defects of arteries has been definitely established. Up to the present, the implantation of a section of an artery has been the best procedure for replacing an arterial defect; vein implantation is less desirable because thrombosis and occlusion not infrequently supervene. Similarly an arterial patch has been described by Carrel as the best method of substitution for lateral (subtotal) defects of arteries. Subsequently he investigated in two experiments the surgical possibilities in the use of a patch consisting of peritoneum and adjacent musculature. In one experiment a small part of the abdominal aorta was replaced in this manner; in the second, a section 12 millimeters in length and a third of the aortic circumference in width, was patched. Carrel[1] reported that "the adaptation of the peritoneal patch to the aortic wall was so perfect that the vessel, less than two years after the operation, was absolutely normal. Although the new wall was composed of tissues different from normal, the morphology of the aorta was not modified." This, then, is a demonstration that a small lateral defect of an artery can be satisfactorily replaced by a transplant other than a vessel wall but approximating arterial structure in the smooth peritoneal lining on one side and the attached muscle on the other.

[1] Carrel, A. J. Exp. Med., 1910, xii, No. 2.

The purpose of the present communication is to demonstrate that fascia is as serviceable as vessel wall or peritoneum-muscle for the replacement of even large lateral defects of the major arteries and, at the same time, offers greater possibilities for clinical application in the appropriate problems encountered in human surgery.

Except in the hands of a master of the technique of blood-vessel surgery, the simple end-to-end suture of a divided vessel results in failure in almost 50 per cent of the experimental attempts. The special technique required for the various steps of this operation is too well known to be detailed. In patching an arterial defect with a section of artery or vein or peritoneum-muscle, the same accurate apposition of intima of vessel to intima (or peritoneum) of transplant is essential, avoidance of any trauma to the inner lining of the transplant is necessary, special suture material must be used, etc. In short, the same

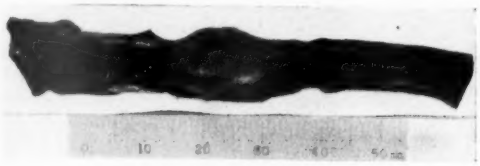


Fig. 1. Seven months after fascia transplantation into defect of the thoracic aorta. The patch lies between 13 and 40 on the ruled scale. Its apparent dilatation is due to contraction of the aortic wall after removal of the specimen.

Fig. 2. Microphotograph of central end of junction of transplant with thoracic aorta. *A*, Aortic wall with deposits of lime salts among the elastic fibers. *B*, *C*, Old organized thrombus fusing with the altered transplant. *D*, *E*, Silk suture, encrusted with lime salts, marking junction between transplant and aorta.

painstaking technique as that for end-to-end suture of an artery must be carried out to insure any measure of success and, the operation being more complicated (and the use of a transplant being involved), an even higher percentage of failures can be expected.

From the reports of microscopic examinations of transplants of vessels made by a number of observers,[1] it appeared to me that it was not imperative to employ like (artery, vein), or even morphologically similar (peritoneum muscle) tissues adequately to replace lateral arterial defects. Indeed, I believed that, theoretically, a simple, strong connective tissue (fascia) would offer several advantages, for it could be used without fear of damaging a delicate intima, without the necessity of accurate apposition of layers, in other words, without all the refinements of technique essential to the success of the other transplants. Apart from considerations of technique, the chances for the success of a fascial graft appeared inherently greater than those of such (relatively) highly differentiated tissues as artery or peritoneum-muscle. Finally, I have shown [2] that defects of other hollow viscera, œsophagus, trachea, stomach, bladder, etc., can be adequately replaced by fascia, the tissues occupying the gap being permanently resistant, and regeneration of the lining membrane and some other elements of the organ that had been bridged occurring regularly.

[1] A discussion of the subject of the viability of transplanted arteries or veins being irrelevant, it will suffice to say that the question is by no means universally agreed upon. There is certainly much histologic evidence pointing to the considerable regenerative power of parts of a vessel wall, particularly the endothelium, in conditions other than experiments with grafts.

[2] Neuhof, H. Surg., Gynec. and Obst., 1917, xxiv, 383.

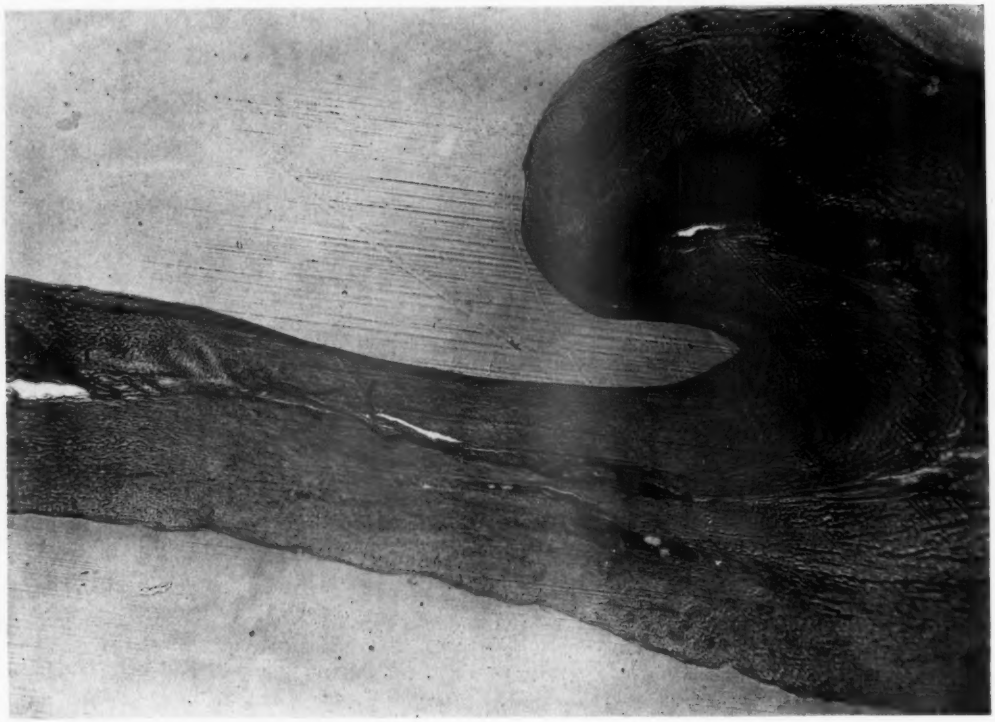
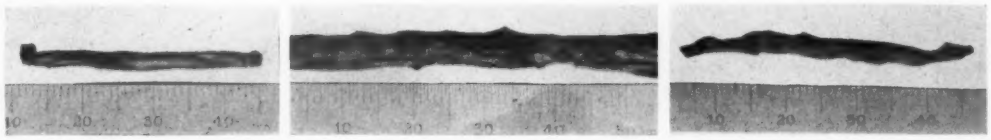


Fig. 3. Microphotograph of distal end of junction of transplant with thoracic aorta. The deposition of lime salts is chiefly in the elastica of the aorta. The free surface of the closely woven connective tissue of the defect is smooth, the lining endothelium-like cells not showing in the picture. The distortion of the junction between transplant and aorta is explained in the text.

Turning to the question of the possible clinical applicability of the various tissue grafts that have been employed for lateral arterial defects, it is clear that the surgical conditions involving their use will be almost invariably emergency ones encountered by the general, and not the specially skilled blood-vessel surgeon. It is evident that autotransplants of pieces of artery are not obtainable in human surgery and are, therefore, not to be considered. Vein grafts are more feasible. To obtain them, however, a separate wound exposure may be required, valuable time would be sacrificed for the careful dissection and proper preparation of the transplant (secondary hæmorrhage and death followed in both instances in which they were used to patch the aorta[1]), and the necessary ligation of a large venous trunk is never desirable and by no means always harmless. The abdomen would not be opened merely to obtain peritoneum muscle transplants; their applicability would, therefore, be sharply limited to lateral defects of intra-abdominal vessels, and, as has been said, would involve special preparations and elaborate technique for their removal and successful transference. Autotransplants of fascia (aponeurosis) are accessible in the neighborhood of almost every operation wound. Fascia lata, however, because of its strength, smoothness, and even consistency, is best suited for grafting. It is readily obtainable in a very few minutes in unlimited quantities for practical purposes, and the removal of the portion required is harmless.

To determine if a fascia transplant can fulfill them, the essential requirements for a

[1] Carrel, A. Ann. Surg., Phila., 1910, July.



A. *B.* *C.*

Fig. 4, *A*. Seven months after transplantation of fascia into defect of the carotid artery. The patch lies between 22 and 40 on the ruled scale.

Fig. 4, *B*. Six months after fascia transplantation into defect of the abdominal aorta. Patch lies between 10 and 37 on ruled scale.

Fig. 4, *C*, Six months after fascia transplantation into defect of the femoral artery. Patch lies between 15 and 34 on the ruled scale.

tissue graft for a lateral arterial defect must be considered. The transplant should not act as a foreign body. There must be the minimal possibility for the development of thrombosis and occlusion. If the graft does not remain viable the site of the defect must be occupied by a permanently resistant mass of connective tissue (preventing the possibility of aneurismal dilatation), smoothly lined on its inner surface, and not encroaching on the lumen of the vessel. The replacement of large defects must be feasible, for small ones can be closed by simple suture. To establish its clinical applicability the graft should be transplantable under unfavorable circumstances — in the presence of incomplete hæmostasis of the artery receiving it—for large defects of the smaller arteries, for the thoracic aorta where pressure is highest and prolonged obstruction of the arterial current is not possible. Finally, to repeat, the technique and armamentarium involved in obtaining and implanting the graft must be simple to be universally applicable.

The results of the experiments to be reported show that all these requirements were fulfilled by the use of fascia transplants. Seven experiments were performed, all on dogs, of which four were followed for sufficiently long periods (six to nine months) to report the more permanent results. In only one—fascia replacement of a large defect of the abdominal aorta involving almost the entire circumference—did hæmorrhage follow, and, in this experiment total resection with tubulization by another vessel would have been a more logical procedure. The outcome was good, practically, but poor, histologically; in one (femoral artery), thrombosis and canalization in a small area having supervened. The results of all the other experiments were entirely satisfactory, anatomically, functionally, and histologically.

The technique of operation was very simple. Except for the addition of sterile vaseline and unusually fine sewing silk, no changes were made from the usual operating-room asepsis and armamentarium of our animal labora-

Fig. 5. Drawing of transverse section through transplant in abdominal aorta. The section replaced by fascia is the lower half of the picture, the termination of the aortic wall being indicated by the endings of the elastic lamina and by the situation of the silk sutures. The apparent dilatation of the transplant is due to contraction of the aortic wall as explained in text.

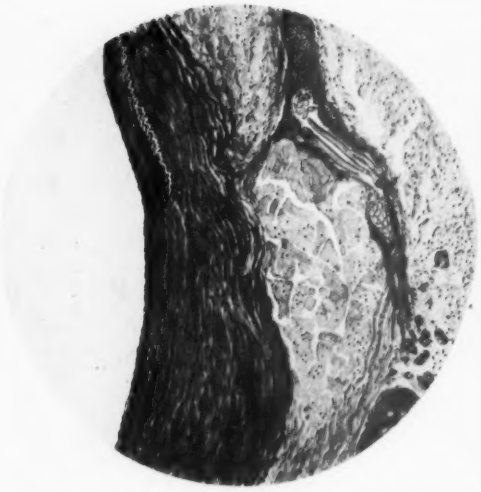


Fig. 6. High power drawing of junction between abdominal aorta and transplant, to show intimate fusion between the two, the lining layer of cells facing the lumen, the stoppage of the elastic lamina and the silk suture marking the site of transition.

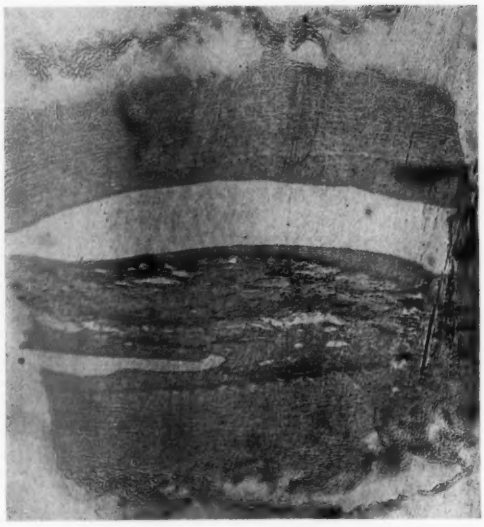


Fig. 7. Slightly oblique section through carotid artery at site of transplantation. Above, the arterial wall; below the altered transplant, with free surface smooth, and deeper layers occupied by old blood pigments.

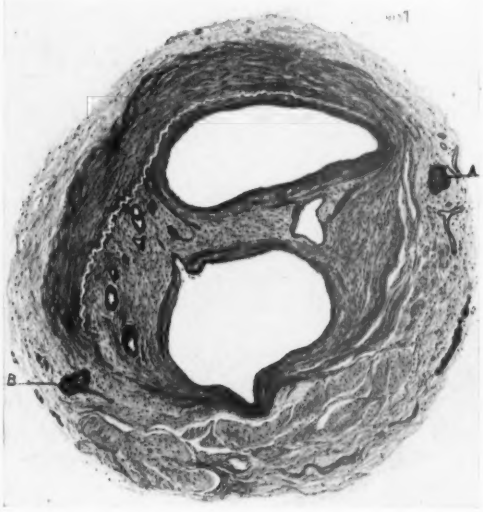


Fig. 8. Drawing to show the old organized thrombus occupying a part of the transplanted section of the femoral artery. The arterial wall is indicated by the elastic lamina, the half replaced by fascia, beginning, approximately, at the silk sutures, *A*, *B*. The lining, flat, endothelium-like cells, and well-developed walls of the vessels canalizing the thrombus, are well shown.

tory.[1] Ether by intratracheal insufflation was used for the operation on the thoracic aorta; by the rebreathing method for the other experiments. The artery is exposed, the portion from which the piece is to be taken is isolated, its hæmostasis is established by a rubber-protected clamp at each end and the ligation or temporary clamping of branches of the artery between them. The desired section of the wall of the artery is then excised and the defect measured with a sterilized steel tape. Blood in the interior of the vessel is washed away and a gauze sponge, freely spread with vaseline, is placed over the exposed lumen. The fascia lata is then laid bare near the knee-joint, a section of the desired shape and of slightly larger size is measured off, removed, dipped in vaseline, and immediately placed over the arterial defect with its smoother surface facing the lumen. It is fixed in place by four sutures, and a continuous suture, approximating edge of fascia to cut edge of artery, is made between them. Compressing the patch lightly with a piece of

[1] Every effort is made to have this approximate the modern human operating room. For details see a paper by W. C. Clarke and F. W. Bancroft. J. Am. M. Ass., 1914, lxiii.

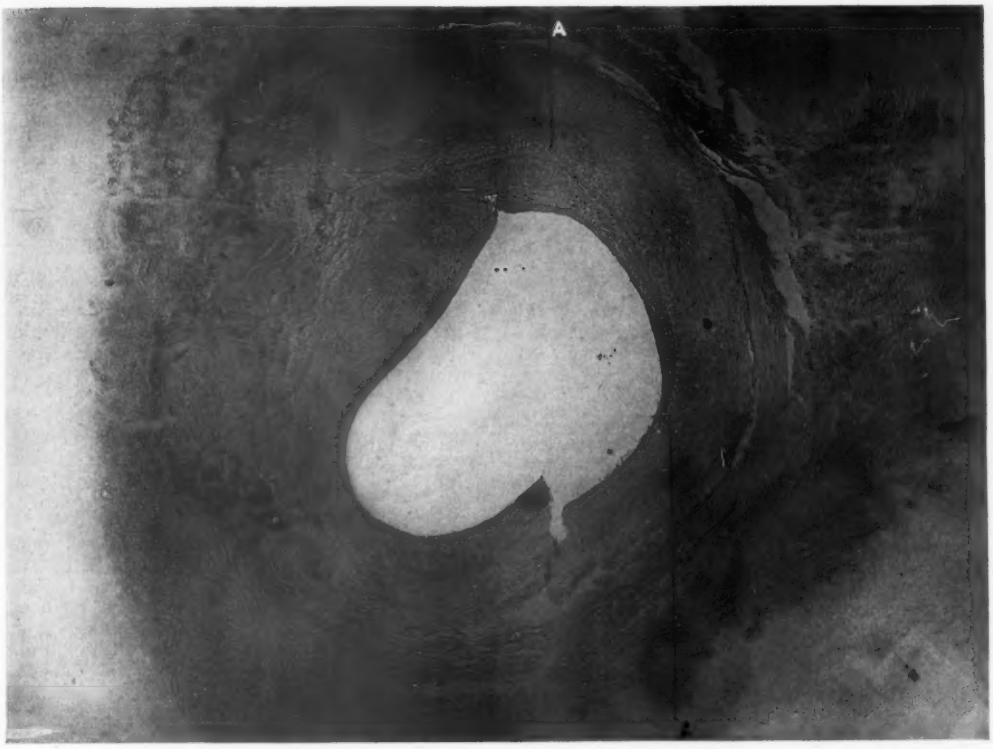


Fig. 9. Microphotograph of the transplanted section of the femoral artery immediately below the thrombosed area, the latter having existed only over a section a few millimeters in length. The elastic lamina, *A*, *A*, indicates the arterial wall.

vaselined gauze, the lower and then the upper clamp on the artery are removed. If there is oozing from gaps between individual stitches, reinforcing ones are passed from the margin of the transplant to the adjoining arterial wall at those places.

Experiment on thoracic aorta. Dog of average size. Intratracheal anæsthesia. Operation, May 17, 1916. Long incision in the seventh left intercostal space with removal of sections of the sixth and seventh ribs. After opening pleura, the lung was packed away from the field of operation. The pleura over the descending thoracic aorta was incised and stripped off. The aorta was clamped off above and below. A section 2x1 centimeters was removed. There was some bleeding although the intercostal vessels were clamped. Fascia was sutured into the defect. A reflected flap of pleura was sutured in place. There was no bleeding upon removal of the clamps. Normal pulsation. The thorax was closed with stab drain at the bottom of the pleural cavity. The dog showed evidences of pneumothorax at the end of operation.

The latter cleared up in a few days. The drain was removed, and the course thereafter uneventful. Chloroform was administered December 16, seven months after operation. There were filamentous adhesions between the surface of the lung and pericardium, line of incision in chest wall, and surface of transplant. When the latter was separated (which was very readily accomplished) the site of the transplant was represented by a smooth, glistening surface, bulging slightly above, not at all below. Normal pulsations of the segment containing the transplant, and of the adjoining segments. The intercostal branches in the region operated upon bled freely. Upon measurement after removal, the size of the patch was the same as when implanted. After fixation in formalin, inspection of the inner surface showed smooth continuity with adjoining aortic lining below, and abrupt demarcation between transplant and vessel intima above. *The apparent aneurismal dilatation of the patch is due to the contraction of the aortic wall*, and the noncontraction of

the transplant after removal (Fig. 1). It was noted in all the specimens and will not be further referred to.

Microscopic examination. Surgical Pathology No. 4182. The site of the defect is occupied by a very closely woven connective tissue, rather richly supplied with nuclei toward the free surface, less and less so toward the depth. This connective tissue, in two layers, represents the original two layers of fascia lata, but the latter cannot be distinguished as such. The external surface of the layer of tissue occupying the defect is smooth; the free surface is for the most part covered by flat, endothelium-like cells. In one area, at the junction with the aortic wall, there is an old, organized thrombus, making a slightly projecting mound; its free surface is smooth. The fusion of the tissues occupying the defect and the adjoining aortic tissues is very intimate so that the line of transition cannot be recognized anywhere; the silk sutures approximately mark it. There is some calcification in the aortic wall near the margin of the defect, but almost none in the tissues of the defect (Figs. 2 and 3).

Experiment on abdominal aorta. Rather large dog. Operation April 26, 1916. The abdominal aorta was isolated for several centimeters above its bifurcation. Clamps were applied, and an oval defect made, 2½ centimeters long, about half the circumference in diameter. There was slight to moderate bleeding from the upper end throughout operation. A fascia transplant was sutured into the defect. Several additional stitches were required.

The postoperative course was uneventful. Normal pulsation in femoral vessels. Chloroform was administered October 11, 1916, six months after operation. A thin connective-tissue adhesion indicated the site of the transplantation, which was indistinguishable otherwise from the adjoining aorta. In the region operated on, the expansile pulsations of the aorta were normal, in every way identical with those of adjacent portions of the vessel. In removing the specimen the branches from the transplanted segment of the aorta bled freely.

Hydrostatic distention of the removed specimen did not reveal any weakness of the new vessel wall. Upon measurement, the latter was found at the same size as when implanted. (Fig. 4, *B*.) Viewed from within after formalin fixation the transplant was represented by a smooth glistening surface continuous with that of the adjoining inner surface of the aorta.

Microscopic examination. Surgical Pathology No. 4136. The fusion between the tissues occupying the defect and the adjoining aorta is even more complete than that described in the previous experiment. The elastic lamina of the intima of the aortic wall ends in the midst of the connective tissue of the defect. The latter is somewhat thicker than the wall of the aorta. It is closely woven, rather rich in nuclei, and not recognizable as fascia. Its free surface is lined by flat endothelium-like cells.

Experiment on carotid artery. Small dog. Operation, March 26, 1916. The left carotid was isolated and clamps applied, and 2 centimeters by ½ centimeter of its wall removed. A somewhat larger section of fascia was implanted. Several additional sutures were placed to control bleeding. Normal pulsation at end of operation.

Postoperative course uneventful. Chloroform administered October 16, seven months after operation. The artery distended evenly with pulsations. The site of the transplant could not be recognized until the specimen was removed. Normal distention of the isolated specimen upon maximal hydrostatic pressure. (Fig. 4, *A*).

Microscopic examination. Surgical Pathology No. 4138. The appearance of the tissues occupying the defect is similar to that noted in the previous experiments. In this instance they are differentiated from the adjoining carotid wall by numerous small yellow deposits near the free surface, representing old hæmorrhages.

Experiment on femoral artery. Dog of average size. Operation April 12, 1916. The left femoral was isolated near the groin, clamps were applied, and a section measuring 1¼x¼ centimeter removed. Fascia of that size was implanted. There was considerable bleeding after removal of clamps requiring many reinforcing sutures. At the end of the operation, there was slight stenosis at lower part of transplanted area, but through pulsation.

The postoperative course was complicated by the development of mange. Administration of chloroform October 11, six months after operation. The site of the transplant was represented by a dark patch covered by thinly adherent connective tissue. There was no stenosis, but free bleeding when vessel was divided below the transplant.

Microscopic examination. Surgical Pathology No. 4137. Many transverse sections were examined. In a small series, thrombosis and canalization was found, this having existed over a distance of not more than 2 millimeters. The gradual transition from the thrombosed region to the areas beyond, where the usual appearance of transplanted segment existed, could be readily followed. In the thrombosed part of the vessel the elastic lamina and silk sutures on both sides marked the end of the wall of the artery. The thrombosis was old and organized. There were two large and many more smaller canalizing vessels, all, even the smallest, having well developed individual coats. Flat endothelium-like cells occupied the free surfaces of these vessels.

THE CARE OF THE PUERPERAL WOMAN; POLYPOID DECIDUAL ENDOMETRITIS

By ARTHUR J. NYULASY, M.R.C.S. (Eng.), Perth, Australia
Gynecologist to the Perth Hospital

GENERAL INTRODUCTION

THE present war has more than ever demonstrated that the safety of a State depends ultimately on the number of healthy men it produces—patriotism and efficiency in their broadest sense are largely matters of education. Knowledge, therefore, which tends to diminish the morbidity or the mortality from childbirth or from abortion, and which is thus intimately bound up with the wellbeing of womankind, and therefore of the whole race, should at the present stage in our history make an insistent demand on our attention. That this view is acceptable to the profession generally is evidenced by the reception extended to Professor Donald's article in the *British Medical Journal* on "The Care of the Pregnant Woman." But, while we all may be agreed as to the supreme importance of conserving mother and child, we may not all be equally agreed as to the special measures of protection. When this want of agreement involves the death of the mother, and perhaps incidentally of the child, it must argue lack of accurate knowledge on one side or on both, or, worse than all, the application of ascertained scientific fact when the patient's fate is already sealed. In illustration, let me recall a case seen in Perth some years ago. The twenty-three year old wife of a man who had led rather a wild life had been confined ten days earlier, and was now in a condition of profound sepsis. The attending physician was confident that the placenta had come away absolutely perfect, and that no membrane had been left behind. On passing my finger into the uterus I felt numerous, firm, polypoid elevations on the placental site, but could not discover a particle of placenta or of membrane. I removed the polypoid outgrowths, and explained that this was a case of *polypoid decidual endometritis*. The attending physician had barely heard of such a condition, a fact very unfortunate for his young patient, as she continued to deteriorate, and succumbed a few days later. This is but one of many such cases that have come under my observation.

When a case of puerperal septicæmia, such as the foregoing, arises in private midwifery practice, all sorts of explanations are apt to be invoked, such as the "nurse" or the "surroundings," or "contagion," or "puerperal insanity," while the medical attendant has, perchance, a vivid mental picture of the perfectly "clean" uterus drawn so convincingly in books, but seen so seldom beyond their covers in puerperal septicæmia. In my experience in the Perth Hospital and elsewhere a septicæmia following on parturition, and definitely associated with the interior of the uterus, has rarely arisen apart from polypoid decidual endometritis. The objects of the present article are mainly to emphasize the high practical importance of polypoid decidual endometritis, and to indicate the lines of successful treatment.

Fig. 1. Specimen of polypoid decidual endometritis from Pathological Museum, Melbourne University. Death from septicæmia. The uterus has been laid open to show the polypoid decidua. The slit in the specimen marks the site from which sections were obtained for miscroscopic examination. (*Frank Nyulasy.*)

Fig. 2. Section of polypoid decidual endometritis. The photomicrograph shows the venous spaces (dilated capillaries), mostly empty except for a few blood-corpuscles. The arterioles, with the high power, show well marked endarteritis. There is a striking formation of fibrous tissue, with some new muscular elements, and much small round-celled infiltration. (*Frank Nyulasy.*)

Fig. 3. Section of polypoid decidual endometritis. Many thick-walled arterioles are seen lying in the midst of much fibrous and some muscular tissue; there was also some small round-celled infiltration. No glands could be detected in this or in the preceding section. (*Frank Nyulasy.*)

HISTORICAL AND ETIOLOGICAL

From a single case encountered at the postmortem table in 1861, Virchow invented the term "polypoid decidual endometritis" (*endometritis decidualis polyposa*) to indicate the naked-eye pathology, polypoid eminences being found studding the placental site. In this instance there was clear evidence of syphilis. As this was the first case in which polypoid decidual endometritis had been described, the condition was naturally thought to be one of extreme rarity. The rarity of the condition, however, lies not in its occurrence, but in its recognition, for more recent investigations, and notably those of Ahlfield and of Frank Nyulasy of Melbourne, have demonstrated beyond doubt that, far from being of extreme rarity, polypoid decidual endometritis is relatively common, and accounts for quite a high proportion of cases of adherent placenta, and in that regard alone must be an efficient cause of much morbidity and of many deaths following on childbirth and abortion.

The relative frequency of polypoid decidual endometritis is not difficult to understand when it is borne in mind that probably not less than 10 to 12 per cent of the population of large cities are tainted with syphilis, and that syphilis, in many cases at least, plays an important part in the causation of polypoid decidual endometritis. In one of the most typical instances in my experience (seen with Dr. Hicks), a very densely and universally adherent placenta was removed with the diseased decidua some hours after labor. There was a history of syphilis in the husband dating back somewhat over a year, although the wife had shown no obvious external evidence of infection. The specimens sent to Dr. Frank Nyulasy were such a striking example of syphilitic polypoid decidual endometritis that the incidental microphotographs were embodied in his thesis.

In the Melbourne University Pathological Museum there is a remarkably convincing collection of uteri affected with polypoid decidual endometritis (the women having all died of sepsis), and Professor Sir Harry Allen stated to me that he was satisfied that in a large proportion of the cases there was "an underlying element of syphilis." These specimens had been provisionally labeled as instances of "lumpy placental mark," but, following on Dr. Frank Nyulasy's investiga-

Fig. 2. Section of polypoid decidual endometritis. The photomicrograph shows the venous spaces (dilated capillaries), mostly empty except for a few blood-corpuscles. The arterioles, with the high power, show well marked endarteritis. There is a striking formation of fibrous tissue, with some new muscular elements, and much small round-celled infiltration. (*Frank Nyulasy.*)

Fig. 3. Section of polypoid decidual endometritis. Many thick-walled arterioles are seen lying in the midst of much fibrous and some muscular tissue; there was also some small round-celled infiltration. No glands could be detected in this or in the preceding section. (*Frank Nyulasy.*)

HISTORICAL AND ETIOLOGICAL

From a single case encountered at the postmortem table in 1861, Virchow invented the term "polypoid decidual endometritis" (*endometritis decidualis polyposa*) to indicate the naked-eye pathology, polypoid eminences being found studding the placental site. In this instance there was clear evidence of syphilis. As this was the first case in which polypoid decidual endometritis had been described, the condition was naturally thought to be one of extreme rarity. The rarity of the condition, however, lies not in its occurrence, but in its recognition, for more recent investigations, and notably those of Ahlfield and of Frank Nyulasy of Melbourne, have demonstrated beyond doubt that, far from being of extreme rarity, polypoid decidual endometritis is relatively common, and accounts for quite a high proportion of cases of adherent placenta, and in that regard alone must be an efficient cause of much morbidity and of many deaths following on childbirth and abortion.

The relative frequency of polypoid decidual endometritis is not difficult to understand when it is borne in mind that probably not less than 10 to 12 per cent of the population of large cities are tainted with syphilis, and that syphilis, in many cases at least, plays an important part in the causation of polypoid decidual endometritis. In one of the most typical instances in my experience (seen with Dr. Hicks), a very densely and universally adherent placenta was removed with the diseased decidua some hours after labor. There was a history of syphilis in the husband dating back somewhat over a year, although the wife had shown no obvious external evidence of infection. The specimens sent to Dr. Frank Nyulasy were such a striking example of syphilitic polypoid decidual endometritis that the incidental microphotographs were embodied in his thesis.

In the Melbourne University Pathological Museum there is a remarkably convincing collection of uteri affected with polypoid decidual endometritis (the women having all died of sepsis), and Professor Sir Harry Allen stated to me that he was satisfied that in a large proportion of the cases there was "an underlying element of syphilis." These specimens had been provisionally labeled as instances of "lumpy placental mark," but, following on Dr. Frank Nyulasy's investiga-

tions, they were classified as definite examples of polypoid decidual endometritis.

Although syphilis is a very important etiological factor in polypoid decidual endometritis, it is quite possible that other organisms may be responsible in some cases. It would appear that the essential features of origin are: (1) a low-grade irritant; (2) the irritant acting over a rather long period. It is thus not improbable that the gonococcus or the common pyogenic cocci may be set down as causes. In the Perth Hospital we have not commonly obtained a history of syphilis, although in the sections examined the microscopic features have hardly been distinguishable from those with a definite syphilitic history.

MORBID ANATOMY—TWO TYPES

Polypoid decidual endometritis is a disease of the decidua which may or may not lead to abortion, many of the most typical cases being met with after full-time labor. It mainly affects the placental site, but may extend down to the cervix uteri. In practice it usually presents itself in one of two types: (1) as tough, somewhat rounded, *polypoid* eminences of various sizes; (2) or as leathery *papillomatous* outgrowths.

Before I had come to properly recognize the papillomatous cases I had referred to them as examples of "leathery placenta." Thus, in an earlier paper (1908), in commenting on a case of perforated uterus the result of criminal abortion, I stated that "at autopsy a large amount of leathery placenta was still adherent, although practically all the ordinary spongy placenta had been removed by the curette at operation. What remained could only be peeled off with difficulty even with the uterus laid open on the table." The microscope has invariably proved these cases of "leathery placenta" to be instances of polypoid decidual endometritis. As in the case just referred to, the ordinary spongy placenta can be removed with no great difficulty. It is only when this has been done that the papillomatous character of the decidua becomes manifest.

With extensive and more evenly distributed growth of new fibrous tissue in decidual endometritis, it seems obvious that there may be little evidence of polypoid or of papillomatous outgrowths, but merely a tough, thick, though probably uneven decidua.

A striking and most important feature of polypoid decidual endometritis is the marked tendency of the diseased decidua to undergo infective changes; indeed, Dr. Frank Nyulasy believes that the great majority, if not all, of such cases will within some days present evidence of infection. In the *Transactions of the Australasian Medical Congress* of 1908 he describes polypoid decidual endometritis as follows: "It is neither a hypertrophy nor an adenomatous condition, as formerly taught, but is a combination of chronic endometritis and metritis, exaggerated by pregnancy, and usually showing the signs of acute inflammation grafted upon the old chronic trouble as the result of sepsis." Striking features in microscopic sections are: (1) endarteritis obliterans; (2) very large venous sinuses (dilated capillaries), empty, thrombosed, or organized into fibrous tissue; (3) fibrous tissue formation; (4) actual decidual "islands," or decidual cells over fairly large areas separated by fibrous tissue; (5) small-cell infiltration; (6) new formation of muscular elements projecting as ingrowths into the decidua; (7) glands are seldom seen.

SYMPTOMS

The symptoms may be abortion, adherent placenta, or sepsis after the full-time placenta has come away perfectly "clean." This latter fact is of the highest importance, as in such circumstances the patient may die of blood-poisoning just as effectively as if a large piece of placenta had been left behind. Not only this, but in such a case septicæmia may come on without noticeable fœtor of the lochia. Furthermore, before the actual onset of septic symptoms, the patient may have been feeling well, and showing no rise of pulse or of temperature, when suddenly, after some days, there has been a rigor, or a foul discharge, or both.

Although the temperature, pulse, discharge, and general condition are uncertain criteria of the presence of polypoid decidual endometritis, the progress of involution of the

uterus is always to be depended upon. Thus, the uterus may be found to be unduly large, and the external os patulous, perhaps admitting one or two fingers when it should have contracted down. The uterus should then at once be explored under anæsthesia, and any diseased decidua removed. If this is done in this early stage, the patient will almost certainly recover; if it is not done, she may die of septicæmia.

TREATMENT

Cases of abortion and those following on labor have usually been sent to the Perth Hospital because of the presence of sepsis or of hæmorrhage. As to the proportion of cases of polypoid decidual endometritis, we estimated some years ago that, in a single series of 100 cases, there were at least 80 per cent with adherent placentæ. All the specimens of adherent placentæ microscopically examined showed polypoid decidual endometritis. Altogether, during about eight years, in the Perth Hospital I have handled some 200 cases of the disease, the cases being practically all drawn from the city poor. This suggests that syphilitic infection is rather common in Perth, or that other organisms operate with frequency. Dr. Frank Nyulasy gives the proportion of polypoid decidual endometritis as 3 to 5 per cent of all pregnancies. These figures indicate that it is a relatively common complication of pregnancy.

The treatment adopted has been *prompt removal of the diseased decidua*. I have invariably used the sharpest possible curette on the grounds of its greater safety and greater efficiency. In some marked cases the curette alone will not suffice, and the bare finger-nail must be used in addition to positively dig out the diseased decidua. The uterus was in many cases then packed with iodoform gauze, this being sometimes followed by intra-uterine douching for some days. Dr. Frank Nyulasy thinks highly of his large intra-uterine iodoform bougies.

In connection with curettage, it is to be noted that, on account of the enormous venous sinuses in the diseased decidua of pronounced cases, there may be severe hæmorrhage. Indeed, in occasional instances I have felt constrained, before the curettage was complete, to pack the uterus with iodoform gauze, and subject the patient to a second sitting a few days later. Apart from hæmorrhage, however, more than one sitting may be essential in odd cases. Thus, in a five months' abortion, with a universally adherent placenta, the papillomatous decidua was very difficult to remove, my sharpest curette and finger-nail proving only partially effective after prolonged effort. At a second sitting a few days later, when the temperature and pulse had risen, and the cervical canal contracted, I did an anterior vaginal metrotomy to facilitate removal of the decidua remaining, and even then was ultimately forced to assist the curette with forceps to positively tear away what still remained. The patient made an easy recovery.

In two of the cases in the recent series reported in this article the patient's condition was so poor and the hæmorrhage at operation so profuse, that a portion of the diseased decidua had to be left behind. The uterus was subsequently douched out twice daily for a week or two, the patients recovering without further operative interference. It would appear, then, that in some cases, at least, the vascular connection between the uterus and the diseased decidua is so good that a certain amount of the decidua may be left, and that the shreds brought away in subsequent douchings probably represent the necrosis of the outlying portions of the papillomata.

Proceeding on the lines indicated, I have lost no case of polypoid decidual endometritis in the Perth Hospital (or in private practice) unless pronounced septicæmia was already present, and the death-warrant of the patient practically signed before coming under observation.

SEVEN RECENT CASES

A series of 7 cases of puerperal septicæmia (following on full-time labor) was admitted to the Perth Hospital during a recent three months, my house surgeon, Dr. Ward, supplying the excellent notes from which the following observations are taken.

There was only one instance of true polypoid outgrowths, and in this case there was not the slightest evidence of any adherent placenta. In all the other cases there was adherent placenta, and it was only when this had been got away that the papillomatous decidua was revealed, the "growths" being extremely tough and leathery, and removed with difficulty. In some of the cases, when the diseased decidua had been removed, it was noted that the underlying uterine surface was very firm and tough, as if infiltrated with fibrous tissue. All the cases were admitted critically ill, with a history of rigors, the pulse-rates ranging from 120 to 140, vaginal discharge being unpleasant (except in the true polypoid case without any adherent placenta), the uteri large and soft, and the external os patulous. In addition to removal of the decidua and daily intra-uterine douching, polyvalent antistreptococcic serum was freely employed, and appeared to have value, while transfer to the open air was effected as soon as practicable. Otherwise the treatment was symptomatic. Among the cases which recovered, there were two instances of femoral thrombosis; one of submucous fibroid, which was spontaneously expelled; in another case an acute nephritis (œdema, stupor, albuminuria, hæmaturia) was superimposed on a chronic condition; while in another case an empyæma developed, and was successfully drained.

In one of the two fatal cases the abdomen was opened three weeks after delivery (a week after removal of placenta and decidua) on account of severe pain and tenderness; the septic process had extended directly through the posterior uterine wall, but hysterectomy was inadmissable. In the other fatal case the patient was admitted a month after labor in a critical condition, with a history of rigors a few days before admission; in spite of treatment she progressively deteriorated, becoming drowsy and delirious, with choreiform movements; no autopsy was held.

GENERAL CONCLUSIONS

1. Polypoid decidual endometritis (with or without adherent placenta) is by far the commonest cause of serious puerperal sepsis.

2. Successful treatment consists in early removal of the diseased decidua, with a minimum of injury to the uterine tissue.

3. In skilled hands early removal of the diseased decidua is free from danger. In the presence of definite sepsis, the possible risk of further infecting the uterus may fairly be taken.

4. With early removal of the diseased decidua, the maternal mortality and morbidity are practically eliminated.

REFERENCES

VIRCHOW. Die Krankhafte Geschwuelste, 1864, ii, 478-481.
AHLFELD. Arch. f. Gynaek., 1876, x, 168-176.
WARD. Brit. M. J., 1884, i, 584.
BULIUS. Muenchen. med. Wchnschr, 1896, June, 537-538.
NYULASY, FRANK A. Tr. Austral. M. Cong., 1908; J. Obst. & Gynæc. Brit. Emp., 1909, July.

THE USE OF BULL'S SERUM IN THE TREATMENT OF WOUNDS INFECTED WITH THE BACILLUS AEROGENES CAPSULATUS WELCHII

By ALEXIUS McGLANNAN, M.D., F.A.C.S., Baltimore

In 1892 Welch and Nuttall[1] described an anaerobic encapsulated bacillus, isolated from a body which at postmortem examination showed the presence of emphysematous crackling in various situations. For several reasons it was argued that the emphysema was the result of an antemortem infection and not a cadaveric decomposition. Animal experiments with the organism proved this argument to be based on fact. The organism was named by its discoverer, the bacillus aerogenes capsulatus. The name has since been shortened by popular usage to Welch bacillus.

Later studies were made by Welch and Flexner[2] and the clinical application made by Bloodgood[3] who pointed out the principle involved in the correct treatment. Several other clinical reports found their way into the literature, but the subject did not attract great attention until the present war brought out an immense number of cases of infection with the organism; 70 per cent of wounds reported by Taylor[4] and nearly 90 per cent by Fleming.[5] From such frequent infections the number of cases of gas gangrene has been very large.

Considerable success may be obtained in preventing gangrene if the infected wound is seen and treated early. However, the rapidity with which the infection and gangrene may develop is shown in Bowlby's[6] report of a case in which the gas was present 5 hours after the wound was received; gangrene and death following in 16 hours.

The organism grows on dead muscle and similarly damaged soft tissue, and the infection spreads along the sheath of the large vessels and nerves. The treatment of the infection, therefore, requires the removal of all such damaged tissue, the opening up of the course of the vessels and the use of suitable disinfectants. Of the antiseptics employed, Dakin's solution is the most efficacious for reasons to be given later. The surgical removal of the damaged tissue will often require the nicest judgment in deciding between excision and amputation.

The infected muscle is easily recognized by its loss of contractility and its dirty brick red color as distinguished from the purple brown of the normal tissue. The usefulness of the limb after removal of all such tissue becomes an important factor in deciding for or against amputation.

The diagnosis of the infection is not difficult. The organism may be recognized in cover slip preparations and in 24 hour cultures. Routine examination of all suspicious wounds by these methods will permit a diagnosis in many cases before the development of gas and of gangrene.

Several theories have been advanced for the development of the gangrene and of the toxæmia in this infection. The decomposition products of the infected tissue; endotoxin absorption, acidæmia and antitryptic action, have each been advanced as the cause of the destructive action and fatal termination of the infection. Kenneth Taylor[7] advanced a theory that gangrene was produced by the pressure of the confined gas on the blood-vessels, causing necrosis, the necrotic tissue then being disorganized as the result of invasion by putrefactive organisms. He argued that the Welch bacillus acting as a saphrophyte attacks the carbohydrates of the muscle producing the great quantity of gas required for the pressure. Taylor made a contrast between the action of the tetanus bacillus and that of the Welch bacillus in the body.

Carrol G. Bull and Ida Pritchett[8] of the Rockefeller Institute not only describe the true action of the Welch bacillus in producing

[1] Johns Hopkins Hosp. Bull., 1892, lii, 81.
[2] J. Exp. Med., 1896, i, 24.
[3] Progressive Med., 1899, Dec.
[4] Lancet, Lond., 1916, Jan. 15, 123. Also previous reports.
[5] Lancet, Lond., 1915, Sept. 18, 638.
[6] Brit. J. Surg., 1915, p. 151.
[7] Bull. Johns Hopkins Hosp., 1916, xxvi, 297.
[8] J. Exp. Med., 1917, xxvi, 119.

gangrene and toxæmia, but also publish the production of an antitoxic serum.

This study proves that a highly potent soluble toxic agent is regularly produced by the bacilli on which their poisonous or lethal action depends. This toxic agent is an exotoxin and in this manner resembles the toxin of the bacillus of tetanus. The toxin produces two sets of effects, according to the manner of injection into animals: (a) hæmolysis, following intravenous injection; (b) inflammation and necrosis of subcutaneous tissue and muscle, following injection into these structures. In this action the toxin resembles the effects produced by the bacteria themselves. Suitable injection of a rabbit with the filtrate of a culture of the bacillus, produced a blood serum capable of neutralizing the toxic substance causing the inflammation and necrosis and also neutralizing the specific hæmolysin. It is interesting to note that *in vitro*, five minutes' contact with Dakin's solution will destroy the toxin.

In an infection with the Welch bacillus, it is shown experimentally that the injection of this antitoxic serum will prevent the development of the spores into the vegetative bacilli; and also that the serum will deprive the vegetative bacilli of their toxic products, which now appear to be their real offensive instrument.

The chief danger from infection with the Welch bacillus is essentially similar to that following tetanus infection. In both cases the toxic agent is an endotoxin yielded by the multiplying organisms at the focus of infection. There is, however, great difference in the local action of the two toxins. Tetanus toxin has little local effect, while the Welch toxin produces marked inflammatory and necrotic change in the local tissue. The Welch bacilli, therefore, grow abundantly, producing wide destruction of tissue, in which process they are soon assisted by the ordinary pyogenic micro-organisms.

We have, therefore, in the presence of gas gangrene two processes to combat:

1. The local growth of the bacteria which produces the toxin and is in turn assisted by the action of this toxin on the tissues.

2. The systemic effect of absorption of the toxin. The extent of this absorption is easiest measured by the degree of hæmolysis shown by the diminution in the number of the red blood cells. The temperature and pulse rate also indicate the extent of toxæmia.

Injection of the antitoxic serum will neutralize both processes. The progress of detoxication may be followed by counting the increasing number of red corpuscles. When sufficient antitoxin has been administered, the increase will be rapid, a difference of from one-half to one million cells will be noted in two hours. With this increase there will be a fall in the temperature and pulse rate.

As soon as the condition of the patient warrants operation, the gangrenous tissue must be removed by amputation or excision. This is important, because re-intoxication has seemed to occur by absorption from the necrotic tissue. When amputation is done, the operation must be a circular amputation without flaps; the guillotine method.

The dose of antitoxin used is from 5 to 15 thousand units, 7500 as an average, given intravenously. At the same time about the same quantity is divided between 4 or more intramuscular injections given proximal to the area of infection. The intravenous injection should be repeated in two hours, if no improvement is shown in the temperature, pulse rate and more especially by the increase of red blood cells. Anaphylaxis is not common when the successive injections are given at short intervals of time. The development of an anaphylactic shock under such circumstances, in the presence of gas gangrene, seems to indicate a fatal infection.

Through the kindness of Dr. Flexner and of Dr. Bull I have had the opportunity of treating 3 cases of gas gangrene with the serum. These cases are reported in abstract now:

Case 1. Mercy Hospital. No. 3364. The patient, a white male, age 52, was admitted to the hospital September 20, 1917, following a wound of the right buttock and thigh inflicted by a shotgun, at short range, 36 hours before admission. His temperature was 103°, pulse 120, expression anxious and general appearance that of a patient suffering from a septic infection. The wound of entrance, situated just behind the great trochanter, was small and surrounded by a dark brown area of necrotic skin,

about 3x5 inches, which area crackled on pressure. The exudate on the surface of the wound contained bubbles. There was brawny induration extending back to the tuberosity of the ischium and down the thigh for a distance of 9 or 10 inches.

Immediate operation was performed. An incision was made extending above and below, beyond the indurated area. The necrotic skin was excised. The felt wad of the shell was removed and with it many small shot. The gangrenous tissue was excised until the floor of the wound showed only clean muscle and fascia. A number of blood-vessels were tied with chromic catgut. Carrel tubes were introduced, the wound dressed and instillations of chloramine made every 2 hours The wound was dressed daily and looked healthy, smears showing a few bacilli for the first few days. In spite of this condition of the wound the patient remained toxic, and therefore on September 22 he was given 30 cubic centimeters (7500 units) of antitoxin into a vein of the arm. A similar dose was given on the next day. The patient's condition continued uneventful until the fourteenth day when he developed lockjaw. Five thousand units of tetanus antitoxin were given into his spinal canal and the symptoms disappeared within the next 12 hours. On the eighteenth day, it was noted that the fascia lata appeared necrotic. Smears taken from this area showed gas bacilli. Another dose of the antitoxin against Welch bacillus was given on the twenty-second day and was followed by an anaphylactic reaction. On the thirtieth day, the wound was partially closed by suture and the patient then made an uninterrupted recovery.

CASE 2. Mercy Hospital No. 4242. The patient was a white man, age 39, who was admitted November 7, 1917, on account of a compound comminuted fracture of the right leg and closed fracture of the left leg, caused by an automobile accident. The wounds were disinfected with iodine, the fractures immobilized in padded splints and the patient was given a prophylactic injection of tetanus antitoxin. At 8 p.m. on November 8, it was noted that the patient's temperature had risen suddenly to 102°. The resident surgeon, Dr. Kearney, at once examined the wound of the right leg and noting an emphysema and discoloration, made a cover slip preparation which showed the Welch bacilli. Immediate amputation was performed, the patient being given 30 cubic centimeters of antitoxic serum intravenously on the operating table. The limb was amputated at the lower third of the thigh. The wound was dressed with dichloramine-T in oil (6.5 per cent). The patient continued toxic with fever of 102°. On November 11, he was given another dose of 30 cubic centimeters of antitoxin intravenously and 60 cubic centimeters were given into the muscles of the thigh above the wound.

After this injection the patient developed a severe anaphylactic reaction. His toxæmia became deeper, and although his wound cleaned up, bacilli continued to be present in the smears. On November 20, the dichloramine-T was replaced by instillations of 2 per cent chloramine in water, the patient continued toxic, however, and died November 22. Postmortem examination was not allowed. In this case the severe anaphylactic shock prevented our repeating the use of the serum.

CASE 3. St. Agnes' Hospital. No. 9463. The patient, a white boy, age 11 years, was admitted November 17, 1917, five days after he had received a compound fracture of both bones of the forearm near the wrist-joint. On admission it was noted that the patient was quite toxic, temperature 103°, pulse 136. There was gangrene and crackling in the wound and smears showed the Welch bacillus. The patient was anæsthetized with nitrous oxide and the wound opened up. At the same time a dose of 30 cubic centimeters of antitoxin was given into a vein in the other arm. Exploration of the region of the fracture showed gangrene involving the pronator quadratus and the tendons of the deep flexors. Opening up the forearm near the elbow revealed gas and gangrene along the course of the interosseous vessels. There was also gangrene at the attachment of the muscles to the internal condyle. Circular amputation was, therefore, done at the middle of the humerus. The vessels were ligated with chromic catgut. Carrel-Dakin disinfection was begun at once. The patient improved rapidly and on the twentieth day the protruding bone was sawed off and the stump closed by sutures. The wound then healed and the patient left the hospital a week after the closure.

DEPARTMENT OF TECHNIQUE

A UNIVERSAL FRACTURE FRAME COMBINING SUSPENSION WITH TRACTION OF THE LOWER OR UPPER EXTREMITY AND FLUOROSCOPIC CONTROL

Especially Useful in Military Surgery

By GEORGE W. HAWLEY, M.D., Bridgeport, Connecticut

ONE of the great difficulties in the treatment of fractures of the major bones of the extremities, is the fact that so many different apparatus are needed to meet so many different conditions. This is still further complicated when fractures are associated with wounds of the soft parts, as occur in such large numbers in modern warfare.

In order to simplify the problem I have designed a frame upon which the patient is placed and upon which he remains during all recumbent treatment and from which he does not have to be moved for any cause. He can be subjected to roentgen examination, transportation, wound treatment, application of plaster, and even operation, without disturbing the limb in any way. Attachments are provided, which furnish suspension or extension to either upper or lower extremity by the ordinary moleskin plaster straps, by the Collin's ankle strap, the Steinmann nail, the Finochietto stirrup (Fig. 1), or the author's combination stirrup (Fig. 2).

Any one of three methods of suspension may be used, all of which give complete exposure of limb for examination and wound treatment. The frame is so constructed that fluoroscopic examination can be had at any time without disturbing the limb or the traction. This permits of accurate and frequent roentgenologic control, and is especially advantageous in military surgery for the location of foreign bodies as well as the approximation of the fracture.

When a case of fracture enters a civil hospital, the immediate requirement is some sort of a temporary splint. Then the case must be submitted to roentgen examination. This requires transferring the patient from the bed to wheel stretcher, stretcher to roentgen table, and then the process reversed. In case portable beds are used, it is still necessary to transfer the patient from the bed to the table.

In any case, it is generally necessary to remove the temporary splint and reapply it. All this entails unnecessary pain and traumatism, which provides muscular spasm and opens the clots over the ends of the bones, increasing the hæmorrhage and subsequent swelling.

When continuous traction is used and Buck's, Hodgen's, or other forms of extension splints are applied, it is usually attached to the bed and the patient becomes, as it were, anchored to the bed. In the more elaborate apparatus for extension with suspension, as used in the time of the Civil War, with the modern modifications of the Blake and Balkan splints, the patient is not only fastened to the bed but to an extensive arrangement of overhead framework. While these splints provide effective suspension which is so essential for wound treatment, there are so many parts, so many ropes and pulleys, that it is always a difficult matter to keep the apparatus in working order and the traction in continuous operation.

With the patient in almost any kind of an extension apparatus, it is almost impossible to obtain a roentgenologic examination without releasing the traction and removing the patient from the bed. Even when it is possible to move the patient and the bed, the overhead frame and guy ropes prevent a satisfactory examination, and fluoroscopy is out of the question.

The apparatus herewith presented consists of an ordinary Bradford gas-pipe frame (Fig. 3), across which canvas is stretched in a manner to make it taut and prevent sagging. In the center section are removable slabs so as to give greater stability at the point where the greatest weight is borne. Over the center of the frame is a gas-pipe bridge which can be placed and locked at different points (Fig. 4). This upright serves to support two vertical bars which act as perineal posts and a point of fixation for counter traction. It also serves to support a sling

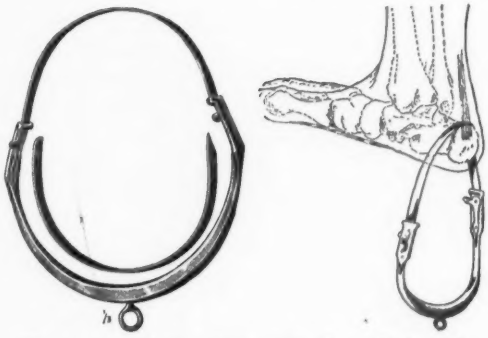


Fig. 1. Finochietto stirrup. Traction obtained by means of a steel band looped over the upper surface of os calcis.

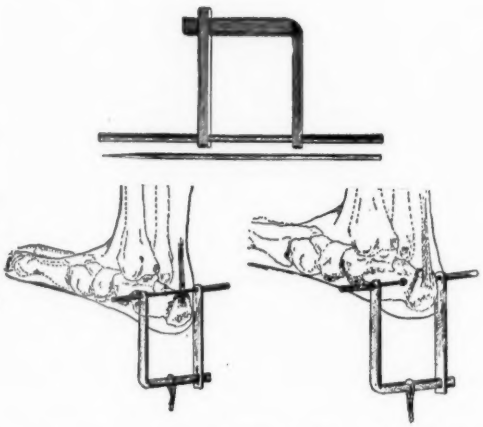


Fig. 2. Author's combination stirrup. Traction by a Steinmann pin resting on superior surface of the os calcis or penetrating the substance of the bone. It may also be used through the tibia or the femur. This stirrup keeps the protruding ends of the pin sterile and prevents tilting and bending. When direct traction is used, ten to fifteen pounds weight is sufficient.

by which the patient's pelvis can be raised for the use of the bed pan (Fig. 9). The perineal posts are lifted out when the bed pan is used. These posts also support a hip rest for the application of plaster (Fig. 5).

At the foot of the frame is an upright which supports two pulleys. The lower pulley is movable for adjustment of elevation. The rope passes under the lower pulley and up over the upper one. The object is to place the weight higher than is usually done, and out of the way. An ordinary Hodgen's hammock splint is used to carry the leg (Fig. 4). To this splint is attached a vertical sliding frame to secure control of the foot and prevent the tendency to outward rotation and toe-drop. The Hodgen's splint is suspended either by a cord attached to the lower and center uprights, or to a bar resting on these uprights. Still another way of suspending the limb is by means of bandage slings dropped down from this bar after the manner of the Balkan splint (Fig. 7).

For treatment of the upper extremity, an angular support is used which is attached to the side of the frame (Fig. 11). Two pulleys are used, the same as on the foot-piece. Traction is applied with the elbow flexed and the hand suspended to a short vertical bar. Either moleskin straps or a padded sling in the bend of the elbow or both, may be used to assure traction.

When it is desired to apply plaster to the lower extremity, after a period of extension, after a wound has healed or after an operation, it can be done by placing a platform under the shoulders and fastening a hip rest to the perineal posts (Fig. 5). The traction on the way may be made secure by tying the pulley rope to the Bradford frame, after removing the weight. The Hodgen's splint is then removed. Before the splint is removed, a Collins' ankle strap is applied and attached directly to the pulley, leaving the leg free and clear with extension still applied. If suspension of the leg at any point, or flexion of the knee is desired, it may be obtained by slings suspended from the horizontal bar (Fig. 8).

In the Carrel treatment of compound fractures, the flask is suspended from the horizontal bar providing a short, direct flow and making a separate standard unnecessary.

This frame is a bed in itself and can be used as an extra cot by placing a support at each end (Fig. 13), or it can be laid upon any bed having a low foot-board. It is a simple matter to obtain elevation of either the foot or the head of the frame as desired.

This frame is also a stretcher or litter in itself and can be used as such. Patients can be transported with comparative ease and comfort, as well as taken out for fresh air treatment.

The original object of this apparatus was to secure fluoroscopic examination of fractures in traction. Believing, with Robert Jones, that extension when efficient, is one of the best methods of treating fractures of the femur, the problem was to devise some way by which the effect of traction could be observed from day to day without interrupting the continuous pull. The aim is to secure reduction by continuous traction. At the same time, the effect of decreasing or di-

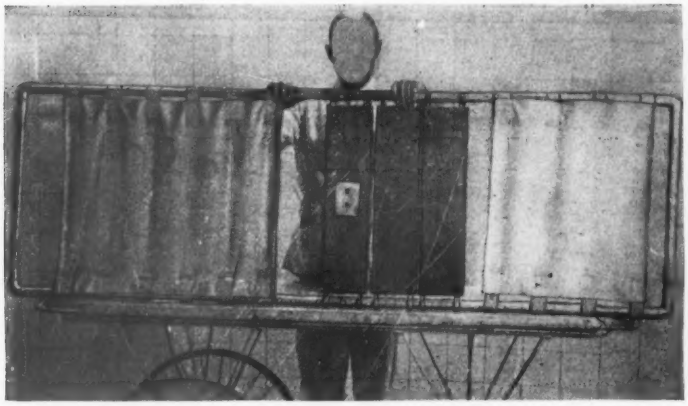


Fig. 3. Author's universal fracture frame showing Bradford frame to which is attached devices for traction, suspension, etc. Canvas across upper and lower sections and removable slats in center where the greatest weight is borne. (Illustrations from photographic enlargements of motion pictures by courtesy of the Clinical Film Company of New York.)

minishing the traction and the effect of manipulation are subject to accurate observation. When reduction has been obtained and held until the fragments are fairly secure (five to fifteen days), then the limb is encased in plaster and the patient is convalescent. The plaster is applied without moving the patient from the frame and without the risk of displacing the fracture ends (Fig. 10). If, however, satisfactory approximation has not been obtained within a week or ten days, then open reduction may be considered, but with an efficient traction apparatus which provides accurate roentgenologic control, with a choice of several methods of applying traction, with the use of sufficient weight applied early with the patient under ether upon a fluoroscopic table, the number of failures of reduction is small and the cases requiring operation are few.

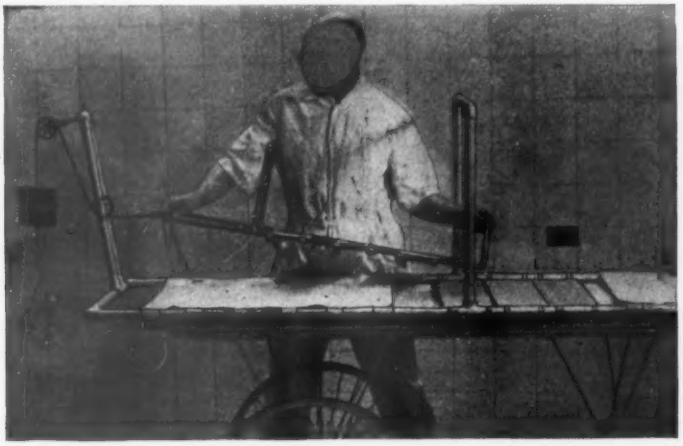


Fig. 4. Frame with central bridge and foot support showing Hodgen's splint attached to weight. Two pulley wheels are used. The lower pulley is adjustable so that the height may be regulated. The upper pulley keeps the weight high and out of the way.

Fig. 5. Frame equipped for application of plaster to the leg. Hip rest on perineal bars. Platform to support head and shoulders.

In the treatment of fractures of the tibia, either continuous or temporary traction may be used. In the former, the direct pull of ten to fifteen pounds on the bone structure itself is the most effective, such as obtained by the Steinmann pin, the Finochietto stirrup (Fig. 1), or the author's combination stirrup (Fig. 2).

The amount of extension secured by adhesive straps is entirely inadequate in fractures below the knee because the traction straps cannot be of sufficient length to support a weight which will control the fragments. Traction by the Collins' ankle strap is also impractical because the pad around the ankle is usually too near the site of fracture and the swelling involves the ankle as well as the leg. Effective temporary traction for immediate reduction of fractures below the knee is obtained by using the author's traction stirrup. It has always been difficult to apply traction at the ankle in order to effect reduction and immobilization of fractures of the tibia. By using this device which

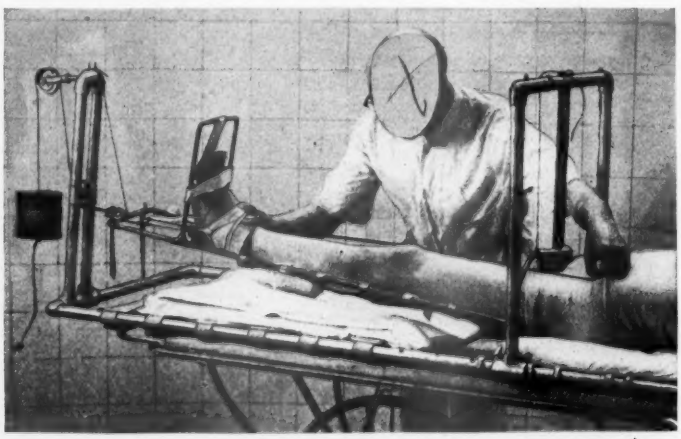


Fig. 6. Patient on frame with traction applied. Traction applied by Collins' ankle strap over heavy felt pad. The Hodgen's splint is suspended by a cord tied at each end, allowing splint to swing like a pendulum. The perineal posts provide counter traction. An adjustable foot piece on the Hodgen's frame serves to prevent toe-drop and rotation deformity. The limb is completely exposed for examination, measurement, and wound treatment. The foot piece is adjustable so that some abduction is possible.

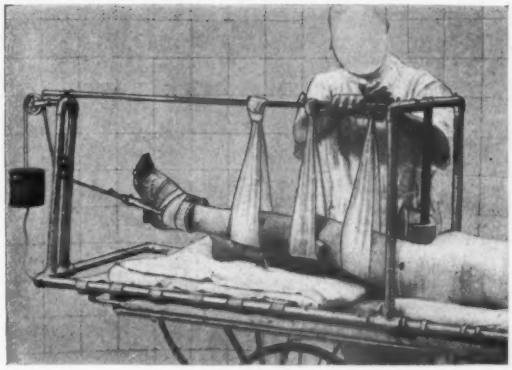


Fig. 7. Frame used to suspend leg like the Balkan splint from a horizontal bar. Useful in posterior wounds.

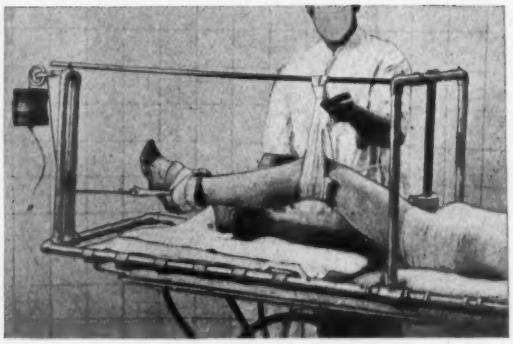


Fig. 8. Frame utilized to obtain traction with knee flexed, similar to double inclined plane.

obtains traction by means of a bar resting on the upper surface of the os calcis, satisfactory control is possible and after a cast is applied the pin can be withdrawn. This temporary traction is rendered accurate when performed on the fracture frame on the fluoroscopic table.

Simplicity is the secret of success with any mechanical device and for this reason all overhead framework and the multiplication of ropes and pulleys has been avoided. At the same time a method of traction has been supplied which is reliable and "fool-proof." Nothing can interfere with the traction after it has once been set up. One of the common defects of the usual methods of employing extension is the fact that they permit of a certain amount of sliding motion which makes it necessary to keep the patient continually pulled toward the head of the bed so that the weights will operate; but as Robert Jones has emphasized, the mechanics of traction presupposes a fixed point from which the pulling force must be obtained. While a moving fixed point is logical as long as the traction force moves with it, nothing is gained thereby except to add the fatal error of unreliability. Traction with the leg in abduction is obtained by using the arm attachment at the foot of the frame on either side. Abduction displacement, except in fractures of the neck of the femur or through the trochanter, is usually an indication that the traction is inefficient. Ordinarily the weight employed is not sufficient. At least 20 to 40 pounds should be used for surface traction and 7 to 15 pounds for direct pull on the bone structure (Steinmann pin, etc.). Pressure on the perineum is relieved by a thick felt pad and elevation of the foot of the frame. The perineal posts may be raised and replaced as the occasion requires. Mattresses made in two sections are used and make the frame as comfortable as any fracture bed.

Fluoroscopy in one plane only is used because a view in an opposite direction is unnecessary. Ocular observation in one plane gives more information than still pictures taken in two planes even stereoscopic impressions, because it is possible to use the effect of motion, to watch the effect of manipulation and different degrees of traction. Roentgenograms furnish an approximate estimate of the relative position of broken fragments. The ability to observe the movements of the fragments by direct fluoroscopy supplies the same information. In addition, it explains something which flat pictures can never do; it demonstrates the effect of

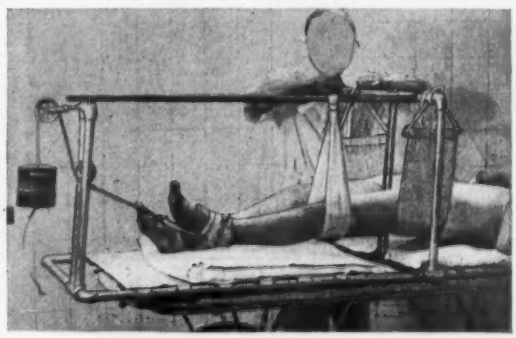


Fig. 9. Sling used to raise patient's pelvis for bed pan and toilet; also for suspending the hip rest for the application of a plaster spica.

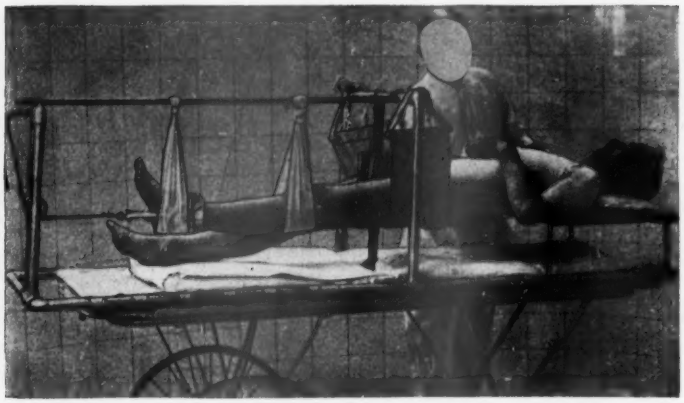


Fig. 10. Patient suspended on hip rest and shoulder support for application of plaster spica. Patient is raised without disturbing limb or traction. Hodgen's splint is removed. Weight of leg may be supported by slings. Traction may be by weight, or rope fastened to lower section of Bradford frame. The sling under the pelvis is removed leaving the patient suspended on the hip rest.

force applied from different directions on the fracture ends and assists in the intelligent efforts to effect replacement.

Fluoroscopy does not take the place of plate impressions which are necessary for permanent record. Both should be utilized wherever the circumstances permit. Fluoroscopic examinations should, of course, be made under proper conditions, with the tubes used for this purpose in a lead-lined box, and with the goggles, gloves and curtains provided for this work. Fluorescent screens, held by hand or supported by a rod which moves with the tube box, may be used. Each has its advantage. With the latter, the surgeon is able to use his own hands for manipulation.

One of the large problems of modern warfare is the treatment of infected compound fractures. These fractures are unlike civil compound fractures because the wounds are extensive and infected, the bones fragmented and complicated by the pressure of shell fragments and clothing. The surgical problem is threefold: the removal of foreign bodies; the treatment of an infected

Fig. 11. Patient with traction applied to arm. Either a padded sling or adhesive straps or both may be used. Two pulley wheels allow for adjustment of the direction of the pull. This position, which brings the arm away from the body, provides adequate exposure for wound treatment and fluoroscopy. (In the apparatus as now constructed a part of the central bridge is used for the arm support.)

Fig. 12. Platform used to suspend pelvis and narrow board used to support spine and head in application of a shoulder spica.

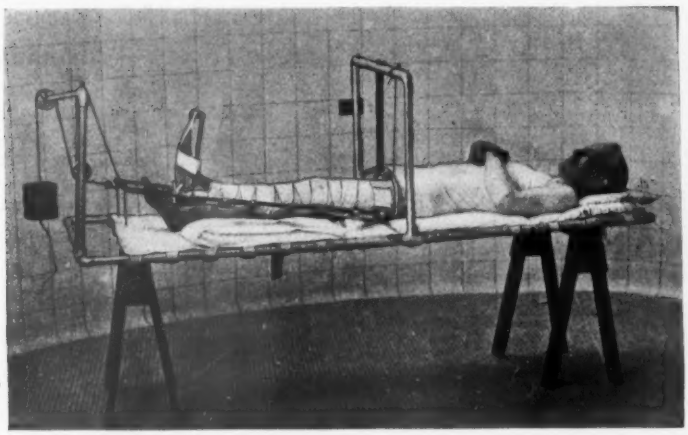


Fig. 13. Frame used as bed or cot by resting it on supports.

wound; and the treatment of a fracture. The localization and excision of substances carried into the tissues makes it necessary to explore and traumatize wounds to a far greater degree than is done in civil surgery. At the same time, more extensive wound treatment is required because infection is the rule. This can only be effectively done by more or less complete exposure of the entire limb. Plaster of Paris has been used with extensive bridging or fenestration, but its use has been almost completely abandoned, because it is laborious when used in a few cases and out of the question when treating large numbers, and the exposure is rarely sufficient.

Some comprehension of the size of this problem is obtained when it is appreciated that 75 per cent of the wounded returned to the base hospitals have wounds associated with fractures. Its importance is further emphasized by the fact that the reconstruction hospitals of England and France are flooded with these cases of fracture deformity, and competent observers agree that at least one-half of these deformities could have been prevented. It is also patent that this field of military surgery has been more or less neglected.

Following a somewhat extensive experience with civil fractures, the writer had the opportunity of treating a large number of military fractures in France and observing many hundreds in various other hospitals. It was apparent from a study of these cases that more efficient and extraordinary measures must be employed to control both the infection and the fracture. If the treatment of the infection is inadequate, the result is chronic osteomyelitis and if the fracture is neglected, deformity is almost inevitable.

In the apparatus herewith described, the endeavor has been to overcome some of the difficulties usually encountered in the treatment of fractures by traction, especially military fractures requiring wound treatment, and at the same time provide effective fluoroscopic control, because this form of roentgenological examination has become of fundamental importance in war surgery and offers a promising field for development in civil fractures. The usefulness of this frame has been confirmed by the tests to which it has been submitted in the treatment of industrial fractures and in some of the war hospitals in France.

NOTE.—Since these photographs were taken a few improvements have been made in the matter of construction. A single bar is used for the upright at the foot of the frame and permanently attached to the frame, folding out of the way when not in use. The central bridge is made in three parts: The two side bars being attached to the frame swinging under the frame when not needed, and a cross-bar which is also used for the arm support with one of the side bars.

CASE OF MINOR DISPLACEMENT OF THE LUMBAR VERTEBRÆ; REPOSITION; CURE

By EDGAR F. CYRIAX, M.D. (Edin.), London

IN the November number of the *Practitioner*,[1] I made a communication on the subject of minor displacements of the vertebræ and ilia. As an illustrative case I submit the following:

Mrs. ——, age 29, came to see me in consultation with Dr. K. F. Lund, on July 13, 1914.

History. During March, 1905, the patient fell backward out of a high trap and struck herself in the middle of the back against the back of the seat on which she was sitting and somersaulted into the road. She was very badly bruised and shaken and her back pained her very much. It was not until 9 months later that she was able to walk with crutches, and not until another 9 months that she was able to walk with only a stick. However, the back did not quite recover, there being persistent pain and rigidity. When she stooped she could not get up again, unless she used her hands to "climb up her legs." The condition slowly improved during the next year, and then remained stationary for about 8 years. Her back remained weak and stiff and she frequently used to "rick her back"; sometimes after sitting in a chair her back would "lock" and she would be unable to move for a minute or so.

Then in March, 1914, the pain and stiffness in the back began to get worse and numbness of the left leg slowly supervened, beginning in the gluteal region and slowly spreading downward until the whole of the leg was involved. There was difficulty in moving the leg and her walk commenced to assume a spastic gait, i.e., when advancing the leg it was moved in a semicircle instead of directly forward. The leg also began to feel constantly cold.

Massage and tapotement were employed at intervals, but with very little effect. The only way that any relief could be obtained was by the patient lying flat on her face and getting someone to press very hard directly downward on the lumbar region.

Examination. Contraction and rigidity of the whole of the lumbar muscles: limitation of all movements in that region, specially rotation to the left. There was deviation of the second lumbar spine to the left of the middle line. There was tenderness on pressure in the lumbar region generally, more particularly at the sides of the second lumbar vertebra where it was more marked on the left side. Pressure on the latter side tended to aggravate the numbness in the leg; pressure on the opposite side did not have this effect.

There was a spongy swelling over the twelfth rib on the right side, accompanied by tenderness on pressure.

A roentgenogram had been taken by Dr. Melville during June, 1914; his report is as follows: "There is malrotation of the second lumbar vertebra, so that the spinous

[1] Practitioner, Lond., 1916, xcvii, 464-471.

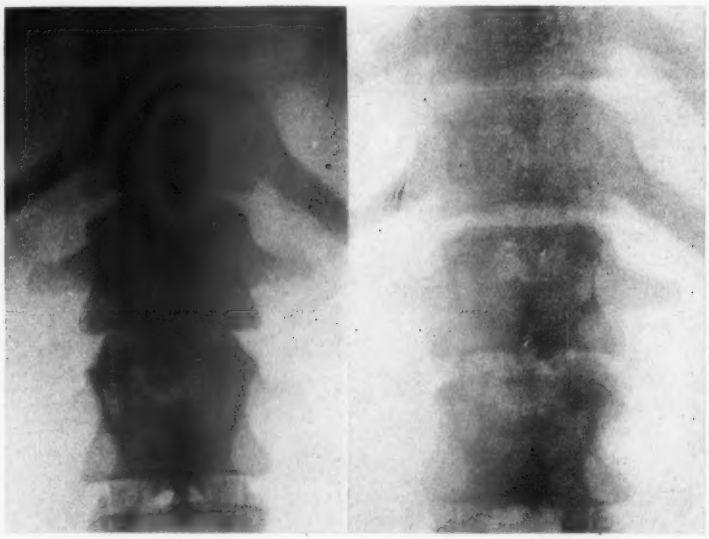


Fig. 1. Roentgenogram taken June, 1914, showing malrotation of second lumbar vertebra.

Fig. 2. Roentgenogram taken March 9, 1915. Malrotation appears to have been corrected.

process is to the left of the middle line" (Fig. 1). As the other vertebræ were in their normal position as regards one another, the second lumbar vertebra was actually producing two subluxations, one between it and the first and the other between it and the third lumbar vertebra.

As there is no lateral deviation of the body of the misplaced lumbar vertebra, it can be assumed that the center of malrotation is situated about the middle of its body. To estimate the amount of malrotation and to express this in degrees one proceeds as follows: The deviation of the spinous process is approximately 2.5 millimeters, and the distance from the tip of this process to the middle of the body is about 6 centimeters. Then the tan angle of rotation is $\frac{2.5}{60}$.

Therefore the angle of rotation is 2° 23′. Of course, this is only a rough estimate but it serves to show that an apparently slight displacement is really a large one; the maximum of rotation obtainable under normal conditions in the lumbar vertebræ averages about 2° between each bone. The roentgenogram, therefore, represents an amount of rotation greater than that obtainable in normal subjects, i.e., it is verging on dislocation.

The patellar reflex was more marked on the left than on the right side, and an attempt to elicit ankle clonus induced 1 or 2 jerks; this was not the case on the right side.

Treatment. This was limited to passive adjustment for the lumbar vertebræ and was applied on three occasions only, namely July 13, 15, and 16. The first visit was chiefly taken up by getting the lumbar muscles to relax; during the second visit the second lumbar vertebra moved nearly into position; at the third visit it moved quite into position so that neither inspection nor palpation could detect any deviation from the middle line. The actual reposition was not only absolutely painless but almost free from even ordinary sensation.

The pains and stiffness were already better after the first visit and after the third they, as well as the feeling of numbness, had disappeared. The patient was also able to walk without swinging her leg round in a semicircle. The patient declared herself to be cured. There was no change in the reflexes.

I did not see the patient again until March 9, 1915. There had been no return of any of the symptoms; she has no pain or stiffness and walks as well with the left leg as with the right. The reflexes are now the same in both legs, and are normal.

A second roentgenogram was taken by Dr. Melville on that date; his report is as follows: "The malrotation of the lumbar vertebra appears to have been corrected" (Fig. 2).

A NEW METHOD OF TREATING FILIFORM STRICTURES OF THE URETHRA

By LEO BUERGER, M.D., F.A.C.S., New York

FROM the urological standpoint, it is an interesting observation that the mechanical devices for attacking lesions demanding intravesical cystoscopic procedure have been more successfully developed and more easily applied, than have those for the work in the anterior and posterior urethra, regions seemingly more accessible. Thus it is strange but nevertheless true that the removal of a foreign body from the bladder is much more readily accomplished with our modern instruments (author's operating cystoscope and operating forceps), than if the same is lodged and impacted in the posterior urethra.

Filiform strictures of the urethra, too, belong in the category of those lesions that have hitherto been treated in an amateurish, maladroit, and unskillful fashion. The old, well-tried, venerable, but often nerve-wrecking, frequently unsuccessful procedure recommended by our great masters of urology, consisted in the introduction of a number of filiform bougies, with the hope that one of these might surmount the intricacies of the scarred urethral passage and penetrate into the orifice of the coarctation. For further dilatation, the methods of LeFort and those of Phillips deserve commendation and support, for, by means of their bougies, with the filiform once introduced, the subsequent dilatation becomes a simple procedure. Perhaps the best of all the sounds for dilatation are the bougies or catheters of Phillips, made of shellacked silk.

But even this ingenious idea of the simultaneous use of multiple filiforms oftentimes fails, either because of the eccentric position of the orifice of the stricture, of the intricacies of the urethral channel, or because of some other peculiar mechanical obstacle, which nullifies our efforts to reach the coarctated canal.

A better and more reliable procedure, one that requires the exercise of more technical proficiency, more deftness and experience, is that which exposes the orifice of the stricture through an endoscopic tube, and calls for the insertion of the filiforms under the guidance of the eye. It has been my own routine for a number of years to procede thus in the treatment of all strictures of the urethra that do not at once allow of the passage of a small silk bougie. It is an error of judgment that sanctions the manipulation of numerous bougies of different styles and magnitude through

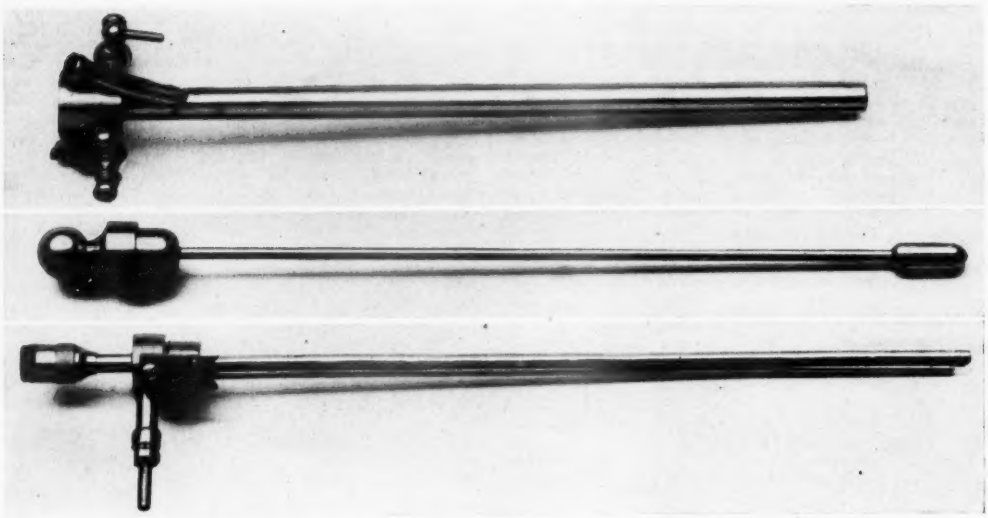


Fig. 1 (at top). New urethroscopic tube with cuff, irrigating faucets, and catheter outlet.

Fig. 2. Obturator for anterior urethra.
Fig. 3. Telescope.

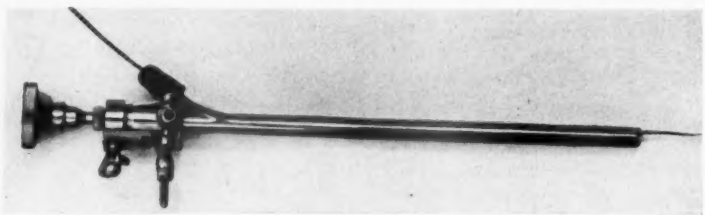


Fig. 4. Author's universal urethroscope with filiform in place.

the urethra, in the hope that mere luck will lead one of these into the devious narrowed passage. For, in the clumsy, haphazard, random insertion of a multitude of instruments, the chances of success are minimized and often completely nullified by the swelling, hæmorrhage, and pain that are occasioned. And, when we consider that cases of filiform coarctation of the urethra very frequently seek our counsel and aid when retention of urine has taken place, success is of vital importance, spelling non-operative relief and often cure, while failure means surgical intervention and its attendant evils, in patients whose renal function is often considerably impaired.

Therefore, I have completely abandoned the time-honored introduction of multiple filiforms, except in those cases where, either because of the multiplicity or the deep situation of the strictures, the endoscopic method of approach is not applicable.

The finding of the orifice of the stricture, however, is not always easy, nor is success in the insertion of the filiform under the guidance of the eye given to any but those whose experience in urological work has been adequate for the execution of the more delicate and intricate maneuvers. In the search for a simpler and more easily executed method, one that could be carried out even by the tyro in the cystoscopic and endoscopic work, it occurred to me that the use of a specially constructed, direct vision irrigation endoscope might solve the problem. And, for this purpose, as well as for other intra-urethral operative procedures, I constructed an operating endoscope which incorporates some of the features of the Goldschmidt and Geiringer instruments. It

differs from the latter, however, in that it has a different optical system, a different type of endoscopic tube and a different catheter outlet, and because it permits of the introduction of operating devices of ample magnitude; in fact, all those suggested for my operating cysto-urethroscope.

Through this instrument it is feasible to pass filiforms of the Phillips type through the orifice of the stricture, directly under the control of the eye, and, in my own experience, it is not difficult to enter strictures that would otherwise be regarded as impassable.

The operating urethroscope[1]. This consists of an ordinary straight endoscopic tube (Fig. 1), somewhat longer than that used for the anterior urethra and is furnished in sizes 22, 24, 26 and 28 French, or even larger if desired, although the 24 is regarded as the normal size. Its ocular end carries the same cuff or reinforcement with irrigating faucets provided in the author's cystoscope, and is lathed out and jointed with water-tight connections. Just beyond the cuff is a large catheter outlet of a pattern used in the author's operating cystoscope. This permits of the introduction of fairly large sized fulguration electrodes, grasping forceps and of a No. 12 Phillips bougie for the dilatation of strictures. Two obturators are furnished; one when the instrument is to be introduced into the bladder for inspection and treatment of the neck of the bladder or posterior urethra, the other when the anterior urethra alone is to be viewed or treated (Fig. 2).

The operating telescope (Fig. 3) consists of a very slender tube carrying a specially designed large angled lens system and a light carrier. When the telescope is fitted into the endoscopic tube, ample room remains for the passage of operating devices, grasping and cutting forceps, large fulguration electrode and filiforms with screw ends, used for the dilatation of strictures and attachable to the Phillips type of bougie.

Although the urethroscopic pictures obtained with this instrument are excellent, it cannot be too strongly emphasized that this type of endoscope is not recommended for routine observation of the posterior urethra. The cysto-urethroscope described by the author, and provided with the right-angled lens system, is far superior in every respect for the study and even for the treatment of the neck of the bladder and posterior urethra, for it permits of repeated introductions and withdrawals without causing the slightest traumatism, maneuvers that are almost always necessary in a thorough investigation of the diseased urethra, while the straight tube type is bound to produce injury if an attempt be made to reintroduce it without the obturator.

Although this instrument has been found adequate in the treatment of filiform strictures of the urethra, a more recent modification, which shall be described in a future publication, is deemed more generally useful in the diagnosis and treatment of lesions in the posterior and anterior urethra. This universal type of cysto-urethroscope is built on the same lines as the one described, except that the light carrier and telescope may be separately removed, so that the conversion of the instrument from a water or irrigation urethroscope into an air and direct vision urethroscope can be more readily accomplished by the simple removal of the telescope.

The treatment of filiform strictures. With the obturator designed for the anterior urethra in place, and the patient in the usual cystoscopic position, the sheath is introduced until it meets the resistance of the strictured area. The obturator is removed and the telescope with the filiform in place is inserted. While the assistant grasps the corpus cavernosum of the penis so as to prevent reflux of fluid, the irrigating fluid is allowed to distend the urethra. The orifice of the stricture is now sought and can often be beautifully demonstrated as a sharply defined black hole, centrally or excentrically placed, at times obscured by a shelf of scarred mucous membrane. By manipulating the filiform back and forth, just as one would a ureteral catheter, and by movements of rotation, it can be readily made to enter the stricture and enter the bladder. The screw end of the filiform is now held or pushed inward and the telescope is withdrawn. Now the sheath or endoscopic tube is removed, care being taken not to dislodge the filiform. The further procedure of dilating the stricture is too well known to require further comment.

Because of the relative shortness of the Phillips filiforms, it might be hazardous to attempt to use the regular lengths for work through the urethroscope. Therefore, specially long filiforms are recommended. If these are not available, the following expedient will permit the operator to accomplish a safe introduction of the filiform, provided that a No. 11 or No. 12 Phillips bougie or catheter is at hand. Introduce the filiform through the catheter outlet armed with a fitting rubber tip until it has passed the stricture and emerges by but 1 centimeter beyond the catheter outlet. Remove the rubber tip and attach either

[1] This special instrument is constructed by the Wappler Electric Company, New York. The first model which was successfully employed in treating the filiform strictures has now been displaced by a new model which shall be described in a future publication.

a No. 11 or No. 12 French, Phillips bougie or catheter whose trumpet-shaped end has been cut off. With the telescope removed, carefully withdraw the endoscopic tube, pushing the bougie inward through the catheter outlet as the endoscope leaves the penis.

Dilatation may then be continued with the Phillips catheter or bougies. Or, an Albarran or Maisononneuve urethrotone may be attached to the filiform already in the urethra, and the stricture cut in the usual fashion.

SUMMARY

In the hands of even those who have had but little experience in cystoscopic work, this method of treating filiform strictures will be found to be so readily carried out, that it will displace the two older inexact and unreliable procedures. It should be instituted not as a method of last resort, but at once before any other procedure has been tried, and as soon as the diagnosis of filiform stricture has been established.

HÆMOLYTIC SPLENOMEGALY CURED BY SPLENECTOMY

By Dr. L. URRUTIA, San Sebastián, Spain

THE number of cases of hæmolytic jaundice which have been treated by splenectomy up to the present time is not more than 50. Therefore, every new well studied observation should be recorded. Another reason for reporting this case is that it is similar in all details to the cases described by Banti under the name of "hæmolytic splenomegaly," of which there are but few cases published.

A. A., age 17, consulted me early in February of this year. Since a child he had had a tendency to diarrhœa which became worse during the last months, there being four to six diarrhœal stools a day, aggravated by eating. The evacuations were liquid and in December, 1916, he had an acute exacerbation with mucus and blood in the stools. A year ago he noticed a swelling in the epigastrium which increased gradually. In September, 1916, he had an attack of jaundice which lasted 8 or 10 days with well colored bowel movements. Since then he has been weak and becomes fatigued with the slightest effort. He is a youth of slight build, attracting attention immediately by the large abdomen, and slight lordosis which causes him to walk as does a woman in pregnancy. His complexion is pale, with a slight jaundice of the scleræ, and a more marked jaundice in the skin of the abdomen and the palms of the hands. There is a large swelling over the epigastrium and left hypochondrium, showing an indolent tumor, movable laterally, extending to the mid-line downward to the level of the umbilicus. On the inner edge a notch can be distinctly felt. There is dullness on percussion upward to the seventh rib in the axillary line.

The inferior edge of the liver is soft and can be felt about an inch and a half below the costal margin. The vertical dullness on percussion is 12 centimeters. Examination of the blood reveals: red cells, 3,000,000; hæmoglobin, 40 per cent; color index, 0.66; white cells, 1,740; polynuclears, 71 per cent; eosinophiles, 1 per cent; large mononuclears, 2 per cent; lymphocytes, 26 per cent.

There are no granular or nucleated red cells. There is a slight poikilocytosis. Normal hæmolysis: H_1 .48—H_2 .42. Absence of hæmolysins (Chauffard-Troisier).

Examination of the serum reveals a marked cholæmia. The urine contains no albumin nor sugar, but there is very marked urobilinuria. The stools are highly colored, liquid, and contain mucus.

Appetite good. There is no itching of the skin and the weight is 107.8 pounds. The mother of the patient has a clear cholæmic complexion and she states that she suffered from an attack of jaundice when pregnant with this child.

We operated on February 16, under ether anæsthesia, with Bevan's left side incision, sectioning the gastrosplenic ligament tied in sections. We divided the phrenosplenic ligament, sectioned the pedicle by the Mayo's two forceps method, taking in deliberately an inch of the tail of the pancreas to avoid any slipping. We covered the stump with a piece of omentum. Two catgut stitches were taken in the pillar of the diaphragma according to Jonnesco, to stop the oozing resulting from the section of the lienophrenic ligament. The wound was closed without drainage.

On the following morning the temperature was 37.5° C.; pulse 84. The examination of the blood gave: white cells, 13,500; polynuclears, 90 per cent; eosinophiles, 2 per cent; large mononuclears, 1 per cent; lymphocytes, 7 per cent.

On February 18, broncopneumonia set in with a consolidation of the right base. Hæmatological examinations were therefore suspended.

On leaving the clinic three weeks after the operation, the blood gave: red cells, 3,500.000; hæmoglobin, 80; white cells, 16,900; polynuclears, 83.6 per cent; eosinophiles, 2 per cent; large mononuclears, 3 per cent; lymphocytes, 11.7 per cent.

The serum contains no bilirubin, but the urobilin still persists in the urine, and there is a slight icterus in the skin and conjunctivæ. On April 19, two months after the operation, we saw the patient again. He is strong and of a good color, and now able to walk in an upright position. The bowels move every 24 hours since he left the clinic. There is no trace of icterus in the "scleræ" nor in the skin, nor is there an indication of urobilin in the urine.

The hepatic dullness is 10 centimeters, weight 110 pounds: red cells, 4,000,000; hæmoglobin, 90; white cells 19,400; polynuclears, 62 per cent; esoinophiles, 3 per cent; large monoclears, 3.6 per cent; lymphocytes, 31.4 per cent.

The spleen (with blood) weighed 2.2 pounds or 1000 grams, and its dimensions are: length, 24 centimeters; width, 20 centimeters; thickness, 7 centimeters.

Microscopically (Dr. R. de Arcaute of Madrid): the chief histologic change was an intense congestion, with perisplenitis and moderate hypertrophy of the trabeculæ, reticulum, and follicles.

This observation is embodied fully in the hepatosplenomegalic variety of acholuric jaundice of Gilbert. This case was one of polycholic, dissociated (purely pigmentary) and acholuric icterus; that is to say, the old form of hæmatogenous jaundice, synonymous at the present time with jaundice through hyperhæmolysis.

We could also present it as a case of acquired chronic hæmolytic jaundice (Hayem-Widal), but we consider it better to call it hæmolytic splenomegaly, as it comprises all the attributes assigned by the celebrated pathologist of Florence, to the morbid entity described by him in 1912 and 1913 in *La Sémaine médicale.*

For Banti, with whose opinion we entirely agree, the name of hæmolytic jaundice is undoubtedly a collective name comprising a number of undefined and unclassified clinical entities differing in their etiology and pathology. In this provisional group he believes to have classed a morbid type the pathogenic factors of which are the following:

1. A hæmolytic agent whose nature and origin in the organism are unknown, is capable of exciting hæmolytic activity in the spleen.

2. A hæmolytic hyperactivity of the spleen due to the cytohæmolysins. This reveals itself morphologically by the increased volume of the organ.

3. Anæmia, a direct consequence of the hyperhæmolysis.

4. Icterus also a consequence of the same.

Of the four pathogenic factors the first three are constant and indispensable, but the fourth is not constant, and may possibly be absent. Therefore the name of hæmolytic jaundice is not adequate in this instance; because jaundice is not a constant symptom. Therefore, it is preferable to call it hæmolytic splenomegaly or hæmolytic splenomegalic anæmia.

The morbic conditions based on this pathogeny are not only represented by hæmolytic splenomegaly, but form a mixed group of cases called splenohæmolytic, comprising in part at least the acquired hæmolytic jaundice of Hayem-Widal, and in part also the congenital hæmolytic jaundice of Minkowski-Chauffard as proved by the results obtained by splenectomy in the case of Roth and that of Zeri and Rubino.

There is a tendency at present among surgeons to consider splenectomy as the treatment par excellence of all cases of hæmolytic jaundice, which is as exaggerated as the conservative opinion of Chauffard who considered them not surgical cases.

We are still wanting in certain details to affirm that all cases of chronic hæmolytic jaundice have as a basis this pathogenic process in which removal of the spleen will assure a cure. For this reason it is useful to distinguish with a particular name the cases in which this pathogenic process is indisputable.

Besides Banti's two cases, there are three other cases in the literature of hæmolytic splenomegaly cured by splenectomy; they are those of Micheli, Antonelli, and Fiori.

REFERENCES

BANTI. La splenomegalie hæmolitique. Sémaine méd., 1912, No. 23.

IDEM. Splénomegalie hæmolitique anhémopoietique. Sémaine méd., 1913, No. 27.

MICHELI. Unmittelbare Effekte der Splenectomie bei einem Fall von erworbenem Haemolitischen splenogalischen Ikterus Typus Hayem-Widal (splenohæmolytischer Ikterus). Wien. klin. Wchnschr., 1911, Sept. 7.

ANTONELLI. Intorno agli itteri emolitici; effeti della splenectomia su di una particolare forma di ittero emolitico acquisito con anemia a tipo perni cioso. Policlin., 1913.

FIORI. Un caso di splenomegalia emolitica trattata colla splenectomia. Sperimentale, 1913.

ETHYL CHLORIDE AS A GENERAL ANÆSTHETIC OF CHOICE IN OPERATIONS OF SHORT DURATION, WITH SPECIAL REFERENCE TO ITS VALUE IN WAR SURGERY

By FREDERIC HAGLER, M.D., St. Louis, and ROBERT L. BOWEN, M.D., Chicago

AN interesting chain of circumstances leads the contributors to offer the following observations.

When our American Unit assumed charge of the Graudenz (Germany) Reserve Hospital No. V, in July, 1916, we found that ethyl chloride had been employed frequently, though not extensively, for inducing general anæsthesia. This practice we immediatley ordered discontinued upon grounds of its extreme danger. The kindly, yet oft-repeated assurances of the assistants and sisters regarding the safety of the method, as well as the very evident reluctance with which it was given up, prompted us to search in the literature of the subject for convincing proof of the grave dangers involved. To our profound astonishment, we discovered in the references no preponderating evidence that our stand was well grounded! Upon the contrary, the majority of quoted authorities recommended ethyl chloride as *safe* and *efficient* when administered for transient anæsthesia. Upon reflection we were reminded that our impressions concerning its danger were based neither upon personal experience (which was nil) nor upon definite information. Our inferences had been drawn rather from the complete omission of the subject by our medical instructors, or its perfunctory dismissal with the admonition *dangerous!* We accordingly gave permission that the practice might be resumed in suitable instances. Our hospital, with a capacity of 450 beds occupied partially by wounded from the front and partially by acute surgical cases from adjacent training camps and prison camps, furnished abundant opportunity for its employment, and the results in a few hundred cases were gratifying in the extreme. This experience proved so instructive that we believe a detailed account of our observations may be of service to many surgeons who possess as little knowledge of the usefulness of ethyl chloride as we did at that time.

In establishing indications for the employment of ethyl chloride as a general anæsthetic agent, we desire to emphasize its suitability *only in cases requiring an anæsthesia of short duration in which local anæsthesia* for one reason or another *is unadapted.* Every surgeon encounters numerous instances in which he hesitates to employ local anæsthesia on account of the time and trouble involved in the preparation of appropriate apparatus and anæsthetic agents. These instances are multiplied in the experience of the military surgeon on active duty. Furthermore, infiltration frequently cannot be easily done on account of inflammatory processes, infection, or inaccessibility of the field. Chloroform and ether possess so many obvious disadvantages as to lead very often to the decision to dispense with anæsthesia altogether; a compromise both unsatisfactory to the surgeon and painful to the patient.

In precisely such instances is ethyl chloride indicated. Reference to our notes shows the following variety of cases in which it was employed: incision and drainage of abscesses (including alveolar and peritonsillar abscess); incision of furuncles; incision and excision of carbuncles; curettage of wounds and ulcers; cautery of wounds and ulcers; enlarging of wounds for drainage; insertion of drains; removal of drains and "packs"; renewal of dressings; loose suturing of gaping wounds; operations for ingrown toe-nail; tenotomy; removal of nails; removal of foreign bodies; incision of tympanic membrane; excision of tissue for examination; as a preliminary to ether; inserting pegs and hooks for extension.

Comment upon the frequency with which these conditions are observed both by civil and military surgeons is scarcely necessary. We were much impressed, however, by the prevalence of abscesses, furuncles, carbuncles, paronychiæ, infected ingrowing nails, suppurating adenitis, etc., among soldiers, and particularly in recruits during their initial period of training. In all these inflammatory conditions local anæsthesia is disagreeable because the hypersensitive, inflamed tissue cannot be painlessly infiltrated. There is further objection that infection may actually be spread by the needle or the infiltrating solution. Curettage and cauterization of wounds to remove neglected exuberant granulations is often necessary. Granulations themselves are not sensitive, but the margin and base of the wound or ulcer are frequently highly sensitive,

as well as too extensive for infiltration. The necessity for enlarging infected wounds and inserting drains arises much less seldom in civil than in war surgery. The same holds true for the removal of heavy packs and large tampons inserted primarily to control hæmorrhage. In war hospitals these must often be removed with great discomfort to the patient unless he be anæsthetized or morphinized, while limited time and exigencies of service often prohibit the latter. Many large lacerated wounds, open stumps, etc., are received from the front with dressings dry, crusted, and firmly adherent. Removal of the dressings in ethyl chloride general anæsthesia is much more humane under these circumstances than rudely tearing them away, and vastly more agreeable to both surgeon and patient than spending valuable time in loosening them by "soaking." Doubtless a wider experience will increase the range of applicability, but these examples suffice to define our conception of the indications for its administration.

TECHNIQUE OF ADMINISTRATION

Preliminary preparation or medication is unnecessary. On general principles it is preferable that the stomach be empty, but by no means do we regularly observe this precaution. Needless to say, all loose objects should be removed from the mouth, and the respiratory passages should be clear. We insisted that mouth-gag, tongue-forceps, etc., be always at hand, although no occasion for using them ever arose. The patient should lie with the head low and the clothing loosened at the neck. Removal of at least the outer clothing is advisable. Restraint is not necessary. However, the patient should be well watched on account of an occasional momentary stage of excitement during the recovery. The eyes are covered and a square of gauze placed over the nose and mouth. This pad should consist of about ten layers of gauze with medium mesh. The patient is instructed to count slowly, and ethyl chloride is then sprayed, or better, rapidly dropped upon the gauze. Within one-half minute to two minutes anæsthesia is complete, as evidenced by the patient ceasing to count, and by the deep, stertorous respiration. The ethyl chloride may be cautiously continued for two or three minutes before being discontinued. The gauze may remain in place because this lengthens the period of narcosis; and having been once withdrawn, we never permit immediate readministration of the anæsthetic. A complete anæsthesia persists for two or three minutes from the discontinuance of the ethyl chloride, after which consciousness returns rapidly, often instantly. An analgesic stage not infrequently precedes and follows the period of profound anæsthesia. There may be a brief stage of excitement just at the waking moment. Perspiration is sometimes profuse, but aside from this there are no unpleasant after-effects. Headache, nausea and vomiting practically never occurred in our experience, and ambulatory patients were permitted to depart unattended within a few minutes after recovery.

When the stage of complete anæsthesia has been reached, it may be easily continued with ether by simply substituting the gauze pad with a mask saturated with ether, and from this point employing the usual drop method. This manner of shortening the period of induction of narcosis is often of great value, especially in military hospitals and dressing stations near the front.

The following averages are furnished from records kept by Miss Emma Gruel, the anæsthetist of our Unit:

The pulse rate immediately prior to the administration of the anæsthesia was 90; immediately after recovery of consciousness, 92; The stage of complete narcosis was reached in slightly more than one minute after beginning the administration, and continued for two minutes after discontinuance. The entire period of complete anæsthesia was slightly less than four minutes. Recovery of consciousness was prompt, and no complications during or following the anæsthesia were noted.

It should be observed that no prolonged anæsthesia was attempted. Although anæsthesia was profound, there was seldom complete muscular relaxation, and on this account the anæsthetic was not satisfactory in the reduction of dislocations and fractures.

SUMMARY

In summarizing our observations we may again state that when clearly indicated and when administered according to the described technique ethyl chloride is preferable to local anæsthesia, because the patient is spared *all* pain, and because there is great conservation of time and energy. In the stress of active military service, simple and time-saving procedures are welcome aids. As compared with ether and chloroform, ethyl chloride has the advantages of being more rapidly effective, of producing a transient anæsthesia from which recovery is immediate, and of freedom from disagreeable after-effects. It is also simple of administration, and in an emergency may be given by persons altogether unskilled in the technique of anæsthesia.

We offer the following conclusions:

1. Ethyl chloride as a general anæsthetic agent has a definite field of usefulness in surgery, and is particularly adapted for use in many conditions peculiar to war surgery.

2. When administered carefully, *and for short periods only*, it is apparently free from danger.

3. It is not suitable for the reduction of fractures and dislocations on account of failure in producing thorough muscular relaxation.

4. Its usefulness deserves wider recognition among members of the profession, and particularly among those at present engaged in the national service.

CORRESPONDENCE

THE FRENCH SERVICE DE SANTÉ IN THE FIELD

To the Editor: Surgeons who come to France for military duty and even those who only read of the work of the French Medical Service, should have some knowledge of the plan of organization and operation of that service. Personally I felt ignorant and confused until I had visited all kinds of sanitary formations and acquired some idea of the plan, and of the meaning of the terms which I constantly heard used. Gradually by sketches and notes I have made the accompanying schema which I believe is fairly correct, and which together with the brief explanations I hope will be useful to others.

Abri (ah-bree) shelter. Usually a "dugout", cave or cellar-like, and sometimes covered with timbers and earth, or with steel plates, or concrete, or all of these.

Blessé (bles-say). One who has received a wound.

Infirmier, infirmiers (An-fir-mee-ay). Hospital Corps men.

Brancard (brah-kar). Stretcher.

Brancadier, brancadiers (brah-kar-dy-ay). Stretcher-bearer. These men carry the wounded from the field, trench or *abri*, as far as the *Poste de Secours Régimental* or to wherever *voitures* may be used. The regiment has 48 *brancadiers* beside 30 or more musicians under command of the band leader. These work forward of the *Postes de Secours Regimental*. In rear of that point transportation either by stretcher or wheeled vehicle is done by the *Brancadiers Divisionaires*.

Brouette brancard. Stretcher mounted upon wheels. It can be taken to pieces in a moment for packing. It is uncomfortable and often injurious to the wounded.

Fiche. Identification tag with notes of injury and treatment. *Première secours*, premiere assistance. First aid is given in the trench or *abri* or upon the field by the *infirmiers* by *brancadiers*, by the batallion doctor or his assistant (3 or 4 batallions to a regiment) or by the wounded himself. A *fiche* is written and tied upon him, and if unable to walk he is transported upon stretcher or the unmerciful *brouette brancard*, to the *Poste de Secours Régimental*.

Voiture sanitaire. Vehicle for transportation of wounded or sick. Ambulance as the word is used in the United States. It may be automobile or horse-drawn. *Voitures* are usually able to work as far forward as the *Postes de Secours Régimental*. If the nature of the ground does not permit this, wounded are carried farther to the rear by *brancardiers*.

Ambulance (ambu-lahns). A movable hospital, together with its means of transportation. It may be larger or smaller but should have all the personnel and material necessary for a complete hospital. The personnel consists of 5 doctors or surgeons, 2 officers of administration (one *gestionnaire* or accoutant, and one *officier d'approvisionment*) and about 60 *infirmiers*. If necessary a bacteriologist and radiologist are added.

Boyau (boy-oh). Trench leading to and from the fighting trenches.

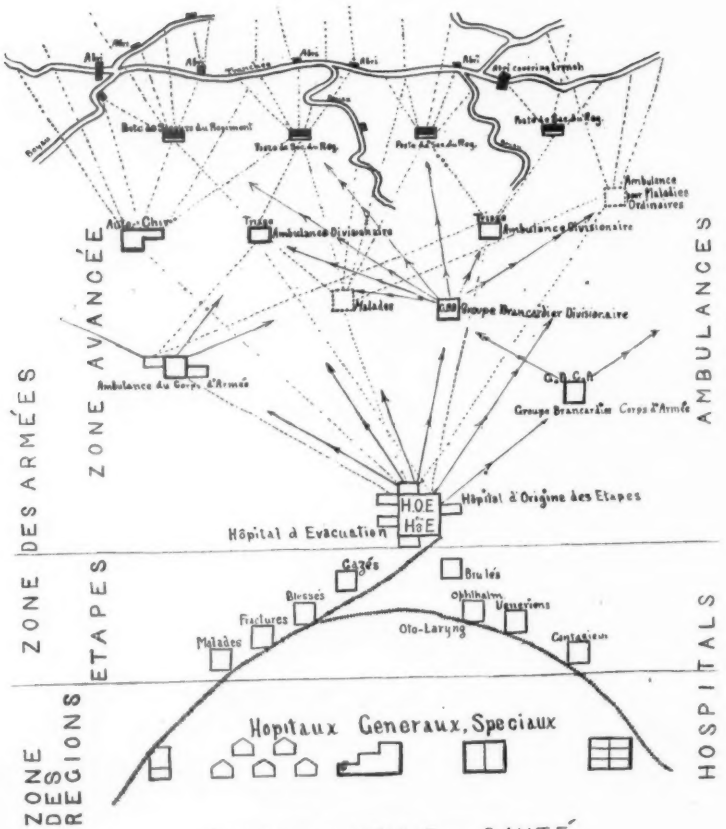
Malades (maladd). Those sick and not wounded. They are not usually treated at surgical ambulances or hospitals, but at separate stations for that purpose.

Poste de Secours du Régiment (post d'suk-kor du Rezh-zhy-mawh). Regimental aid station. In charge of the doctor of the regiment, usually a captain, perhaps a commandant. He has doctors or assistants from the batallions to help him. It is located one, two, or more kilometers behind the fighting lines in the most sheltered spot available, often in a cave or behind a bluff or in the cellar of a ruined house.

Triage (tree-ahjh) *Ambulance Divisionaire*. Ambulance (hospital) for rendering any necessary aid not requiring much delay, to the wounded on his way toward the rear, and especially for classification of patients. It is therefore called *triage* meaning separation or choice. Early surgical intervention may be done here in urgent cases. The *petits blessés* (slightly wounded) and the *petits malades* (slightly sick) are often kept until recovery at the *triage* and from there returned to the front. This station also furnishes more advanced ones with medical personnel and material.

Equipe (ay-keep). A unit or team consisting of one surgeon, one assistant, one anæsthetist, two *infirmiers*. An *equipe* may be graded A or B according to the importance or difficulty of the class of cases it is expected to handle.

Auto-Chir. Ambulance Automobile Chirurgicale. A portable hospital responsible directly to the *Inspecteur Directeur du Service de Santé de l'Armée*. It has an *Officier d'Administration*, and 6 *equipes*, one *Chef d'Laboratoire* who has under his direction a radiologist, a bacteriologist, a chemist, a photographer, and two pharmacists. Near the *Auto-chir* is located an *Ambulance Divisionaire Ordnaire* which furnishes the *infirmiers* of whom there are about 80.



SCHEMA DU SERVICE DE SANTÉ

Esquissé par S.W. KELLEY

Auto-Chirs are often finely equipped both as to personnel and material and are expected to handle *blessés gravés* (severely wounded).

G.B.D. (zhay-bay-day) *Groupe Brancardier Divisionaire.* Division headquarters for *brancardiers* of whom there may be 100 or 150. It is not a hospital. It is in charge of a doctor, who may be a captain a lieutenant, or a sous-lieutenant. Also there is an auxiliary officer (not a doctor), a dentist, 4 chemists (pharmacists). The *G.B.D.* furnishes *brancardiers* to regiments as needed. Usually a part of its duty is to dispose of the dead; identifying them, transporting or burying them, marking the graves and keeping careful records of the work. Nobody brought in is buried until the cross and the data for marking the grave are prepared for immediate placing upon the spot. There is also a clergyman at every *G.B.D.* Then sometimes cooking is done at *G.B.D.* for *Postes de Secours* although it is usually provided for at the latter.

Ambulance du Corps d'Armée. This is an active and important surgical hospital where often much operative work is done; still, patients are not retained here longer than is necessary to render them transportable.

H. O. E. or *HOE* (Ash-oh-ay) is a Hospital which is located at the line dividing the *Zone des Etapes* (or stages of a march) and the *Zone de l'Avant* (before, advanced) and therefore named *Hopital d'Origine des Etapes.* During this war it has often been called *Hopital d'Évacuation.* It is usually at a railhead, and though it may be installed in barracks or even in tents it is more or less permanent for war times. It is really a group of ambulances (hospitals) under one management. It is likely to be in charge of a colonel, a commandant (next grade above captain) or at least a captain, and has a staff of administrative officers. It has not only a *triage* and general surgical but often many special departments, such as for fractures for venereal disease, for ophthalmic, otolaryngologic, for gas-poisoning, for burns, dental and prosthetic cases, and for ordinary illnesses. It has also quite complete radiographic and bacteriologic departments in connection, with specialists in charge. Still it is not intended to be kept filled with patients, but always to have plenty of room for an influx. Consequently, wounded or sick who need a longer stay in the hospital are evacuated still further to the rear as soon as they are transportable. Patients who are

likely to be able to re-enter the service after one, two, or three months, are sent to the *Hopitals des Etapes*, which cover all departments. Others are sent to general and special hospitals of all kinds, or to convalescent camps and homes located in the *Zone des Régions* (interior). *HOE* is generally known and operated as an evacuation hospital.

For convenience, a *Groupe Brancardier Corps d'Armée* is often located near *HOE:* which latter also sends forward *equipes* and medical supplies to other stations if needed.

Elasticity of the service. It is of course, understood that any station may be augmented or diminished in personnel and material from its usual strength, according to exigencies, and that any of the stations may be situated with another or several others; for example, the *Poste de Secours Régimental* may be omitted altogether, or situated farther back and used for *triage*, or *G.B.D.* may be located with *triage*, or there may be one or three, instead of two *triages*, which are something analogous to our dressing stations. There may be *Postes de Secours du Bataillon* instead of those of the regiment, etc.

Also, of course, distances behind the lines and between stations are subject to the widest variation according to the terrain and the nature of the military activities.

The high administrative offices. The entire *Service de Santé* of the French military establishment is under the authority of the *Ministre de la Guerre*, who appoints a *sous-Secretary du Service de Santé;* and next in authority and located at *G.Q.G.* (*Grand Quartier General*) is the *Médecin Inspecteur General Chef Superieur du Service de Santé des Armées d'Operation.* Under him are the *Medecin Inspecteurs Directeurs du Service de Santé de l'Armée*, one for each of France's ten armies. Next in order are the *Médecins, Inspecteurs or Médecins Principaux Directeurs du Service de Santé de Corps d'Armée.* These rank above the *Médecins Divisionaires*, one for each division.

Ambulance des Allies, France.
Samuel W. Kelley, M.D., F.A.C.S.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD APRIL 20, 1917, WITH THE PRESIDENT, DR. CHANNING W. BARRETT, IN THE CHAIR

CÆSAREAN SECTION IN HEART LESIONS

DR. CHARLES E. PADDOCK: A pregnant colored woman, 32 years of age, was admitted at term in her first pregnancy, to the hospital suffering with much dyspnœa, œdema of the lower extremities, and pulmonary œdema. The heart murmurs could not be differentiated, and there was evidence of a dilated right heart with mitral insufficiency and myocarditis. The face was very much congested and swollen, eyes glassy and bulging. The feet and hands and legs were œdematous. The urine showed granular casts and 1 per cent albumin. The cervix was long and undilated. The patient was in a desperate condition. Under gas anæsthesia the classical cæsarean section was performed. A living child weighing 8½ pounds was delivered.

The general œdema gradually disappeared but breathing was very difficult for 10 days. The heart symptoms improved. The prognosis in this case was good.

Two per cent of pregnancies are complicated by heart lesions, and such cases are always serious, the seriousness depending upon the degree of compensation. In many cases the cæsarean operation offers the only hope for the patient.

This second case, a young colored woman, had the pelvic measurements of Baudelocque, 16.5 cubic centimeters, crests 25 cubic centimeters and anterior spines 22.5 cubic centimeters. No date was given as to the last menstruation. The fundus was well up under the ensiform and the head was overriding the symphysis. The head was small, occiput to left and the sutures well open.

The size of head, condition of sutures, and race are important factors in determining the mode of delivery in such cases. A colored woman will usually give birth to a child at term in a contracted pelvis when a white woman would not. This case will be given a "test of labor" and operation will be undertaken only when such test proves the advisability of doing so.

DISCUSSION

DR. N. SPROAT HEANEY: What does Dr. Paddock mean when he speaks of the "test of labor"?

DR. PADDOCK: The woman should be allowed to enter labor, the cervix should be allowed to dilate and it should be observed whether the head molds. The membranes should remain unpunctured.

DR. HEANEY: I have been in doubt whether cæsarean section is ever a procedure of choice in a patient with incompetent heart. One particular thing in the treatment of a patient with an incompetent heart is rest and quiet. After cæsarean section there is considerable pain from the incision and from gas pains, the patient's sleep is disturbed, and the advantage of the rapid delivery is offset by the stormy convalescence and by the operative shock. I have never performed a cæsarean section on a patient with incompetent heart. I prefer to allow the woman to go into labor naturally, preventing her from bearing down as long as possible, giving her morphine to relieve the pains as much as possible, and as soon as the expulsive stage is reached, advise delivery with forceps under deep anæsthesia.

DR. GEORGE W. LEE: Some of our cases in the County Hospital have shown great recuperative power under stimulation, after rupture of the membranes. Usually the first stage of labor is markedly shortened, and there is much less work to be done during dilatation. I believe we should watch these cases closely during dilatation, and upon the observance of any serious indication, deliver through the vagina with complete dilatation, if necessary.

DR. C. S. BACON: I agree with Dr. Heaney's view. Unless there is a contracted pelvis or some reason for anticipating a long and hard labor, the first stage of labor might be easy and relief from possible heart weakness later could be obtained through the use of the forceps.

A conjugata vera of 7½ centimeters means a very small pelvis and the probability of spontaneous delivery is not very great, according to the symposium at the International Congress at Rome, but the general consensus of opinion was that spontaneous labor is usually better than operative delivery. If there were some 33 to 40 per cent of chance of delivery, it would be better to try it. I do not think a four to six hour trial in contracted pelves is sufficient. I think a forty or fifty hour trial is better. The head often does not mold early.

I always try to get the dimensions of the head during the last week by the Mueller impression so that we can get an idea of what the head will do.

DR. GEORGE W. LEE: Race should be considered a factor in these cases.

DR. PADDOCK (closing): There was no gastric disturbance in this case. Catheterization was, however, necessary. This is only my fourth heart case where cæsarean section was performed, and in each case there was a great loss of compensation and the patient was in a very grave condition. Complete recovery has occurred in each.

MIXED TUMOR OF THE OVARY

DR. GEORGE F. DICK: The patient had been sick three weeks. The onset was sudden with pain in the back. There was no chill, fever, or vomiting. The pain extended bilaterally down the back and into the hips. It was dull at first but grew gradually worse.

The heart was slightly enlarged but there were no diagnostic symptoms. The roentgenogram for kidney-stones was negative. The patient was in the hospital about three months, then died. About three weeks before death a number of tumors appeared, one in the shoulder and two on the side of the chest. A pelvic tumor was found. On post-mortem examination the right ovary was found to be not affected; the left ovary was replaced with tumor tissue, but was not enlarged. The uterus was filled with tumor masses varying in size from that of a pin head to a hickory nut. The tumor had spread by way of the lymphatics, involving the glands along the iliac vessels and the aorta so that the tissues around the aorta and the adrenals were embedded in tumor tissue. The posterior and anterior mediastinum were filled with tumor tissue. The pericardial cavity had been invaded and was filled with bloody fluid. The tumor extended into the cavity of the heart. After it reached the heart metastasis took place by way of the blood stream, and bony tumors were found. Tumors were found beneath the impacted mucosa of the stomach. The histology of the tumor was that of typical sarcoma and carcinoma.

ABDOMINAL TUMOR WITH METASTASES

DR. W. J. SCHAFFER: The patient was a negro woman 53 years of age, who entered the hospital, suffering with weakness, loss of weight, vomiting, hoarseness, and shortness of breath, with considerable swelling of the feet and ankles. The trouble was first noticed last January. It began with pain in the right axilla extending down to the groin. Also the upper part of the chest was painful, and the pain was aggravated by breathing, but was not associated with eating. It lasted two weeks, and was followed by vomiting. The vomitus was bitter but contained no blood. The patient became progressively weaker.

On examination, she was found to be slightly emaciated, with slight jaundice of the scleræ and skin. The right ventricle was thought to be dilated. The abdomen was distended, the contents were fluid. The liver was enlarged. There was pain over the costal margin. Some leucocytosis was present. A diagnosis of carcinoma of the liver with ascites and dilated right heart was made.

The patient lived about 48 hours after admission.

On autopsy the thoracic cavity and lungs were found to be very small, but no nodules were present. The heart was fatty and the right ventricle was dilated. The heart was not large. The myocardium was soft and flabby. Two and a half liters of clear fluid exuded from the abdomen. The liver was markedly enlarged to the left and was fatty, weighing over 9 pounds and a half. Just under the capsule were multiple pearl white patches not elevated; there was no puckering, and the centers were not depressed. The gall-bladder was not visible. One-third of the total area of the liver was involved with nodules of varying size up to three centimeters in diameter. The gall-bladder bile was almost white.

In the right kidney a nodule could be palpated. This proved to be a hypernephroma, surrounded by pearly white tissue. No right adrenals could be found; it was probably incorporated in the tissues surrounding the hypernephroma. There were a few fibromyomata. There were no gross tumors in the ovaries or tubes. The autopsy findings indicated this to be a case of primary carcinoma of the kidney with metastases into the liver and into the adrenal glands and into the aorta and lymph aortic glands.

OVARIAN ABSCESS

DR. LESTER E. FRANKENTHAL: An attempt was made by the patient to terminate the pregnancy. She said "something," passed. We found a centrally located tumor reaching from the pubes to within three fingers' breadth of the umbilicus, freely movable, pear-shaped; in position, shape, movability resembling a pregnant uterus. She had an elevation in temperature and also an increased leucocytosis. On bimanual examination we felt certain that this central mass was not the pregnant uterus but an inflammatory mass and that the uterus was placed behind and to the right of the aforesaid mass. Abdominal section was done yesterday morning. We found an ovarian abscess which was adherent to the bowel, abdominal parietes, and bladder. At first we attempted to enucleate the abscessed ovary, but since we found in many places the adhesion between the bowel and the tumor wall too intimate, we desisted, closed off the peritoneal cavity from above and around the tumor by sewing the parietal peritoneum to the walls of the mass.

The skin was turned in all around and sewed on to the fascia. The abscess was then incised to the extent of 2½ to 3 cubic centimeters, a perforated drainage tube inserted, surrounded by gauze. Gauze pack will be removed tomorrow and a shorter drainage tube left *in situ*.

As you will see it is now nearly 34 hours since the operation and the patient is in excellent condition. We are showing this case, first, on account

of the difficulty of making a diagnosis and of eliminating pregnancy, and then on account of the way we treated the abdominal incision before opening the abscess. (The speaker referred to another case, one of uterine pregnancy with distinct Hegar's phenomenon. The cervix and the body of the uterus seemed to be entirely separated one from the other.) The size of the pregnant uterus, its position, its shape, and its movability in this case are identical with the previous case.

DISCUSSION

QUESTION: Is it your opinion that this abscess of the ovary was the result of infection?

DR. FRANKENTHAL: Yes. The infection in pregnancy is more likely to pass up along the ovarian ligament from the uterine cavity than to the tubes. Ovarian abscesses can usually be traced to an infection in a previous pregnancy, which is not the case with tubal abscesses. They usually are caused by gonorrhœal infection.

Since the surgical treatment carries with it a mortality of only 0.5 per cent in well prepared cases, I am bitterly opposed to the X-ray treatment in fibroid tumors of the uterus, for the operation removes the fibroid tumor and, through the removal of the fibroid tumor, does away with all chances of malignancy in that uterus and through the removal of the fibroid tumor the brown atrophy of the heart muscles soon disappears. Moreover, it is frequently impossible to make an absolutely correct diagnosis of the adnexa complications of a fibroid tumor such as cystic ovaries, tubal tumors either of an inflammatory nature or of extra-uterine origin. Ovarian cysts have frequently been mistaken for fibroid tumors and vice versa.

To my mind the X-ray treatment is only indicated in cases of uncompensated heart disease or kidney disease, or in very old women, or in those who are terrified at the prospect of an operation.

We recently operated upon a patient who had received 18 treatments with X-rays for a supposed fibroid tumor of the uterus. The tumor turned out to be an ovarian cyst, freshly adhering to everything an abdominal tumor might become attached to. The adhesions, however, were recent and were easily separated, making the removal of the tumor *in toto* quite possible. The uterus was enlarged, passively congested with the tumor mass on top of it. This accounted for the hæmorrhages from the uterus, which misled the diagnostician.

I will not say how often malignancy occurs in a certain number of cases, because personally I have not had the opportunity of examining each fibroid in every uterus removed for fibroid tumors of the uterus sufficiently carefully to make a percentage statement of any value, but in my experience as well as the experience of every gynecologist, malignancy occurs sufficiently often in our fibroid work every year to make us hesitate to suggest X-ray treatment on that account alone. Besides, the X-ray treatment is frequently followed by various complications as was evidenced in one case in which there was great induration, swelling and itching of the skin over the lower abdominal wall, which condition resembled an elephantiasis.

The literature teaches us that fatal hæmorrhages have occurred after X-ray exposure. The glands of Lieberkuehn can be destroyed in three days in a dog exposed to X-ray and thus a fatal diarrhœa may be produced. The birth of a malformed litter is said to have resulted from X-ray exposure.

The medicolegal aspect of the question is important, since if you recommend X-ray treatment for a uterine fibroid where a malignant tumor may co-exist you might make yourself criminally liable.[1]

DISCUSSION

DR. HEANEY: Do you close the wound ordinarily?

DR. FRANKENTHAL: The wound was kept open and the skin was turned in.

DR. HEANEY: It was brought down to the fascia and covered over the fat after?

DR. FRANKENTHAL: Yes, so as to avoid as much infection of the abdominal wall as possible. The edge of the muscle was not covered because this would render the opening too small.

DR. CURTIS: Would you put radium in the same category with the X-ray so far as its effect on the ovary is concerned?

DR. FRANKENTHAL: No; I would not, because radium does not produce an artificial menopause.

Answering your question more fully, Dr. Curtis, I would say however, that I must include radium with the X-rays in the treatment of fibroid tumors in view of the many complications spoken of before such as malignancy, abscess formation, necrosis, as well as wrong diagnosis when fibroids may be complicated by extra-uterine pregnancy, adnexa diseases, and other complications.

I am reminded of a case that I was asked to see just before she was placed on the operating table to be operated on by another surgeon for a carcinoma of the rectum. I made a diagnosis of a fibroid tumor adhering to the rectum with no rectal disease. The abdomen was opened and my diagnosis was substantiated by the local findings, but, since the surgeon had made an X-ray and clinical diagnosis of carcinoma, he hunted for any disturbance higher up in the bowel, and found high up in the abdomen a stricture of the bowel, which would never have been discovered, had it not been for the abdominal section, and therefore the patient was relieved of her symptoms which would not have been accomplished had she been treated by X-rays for the fibroid tumor.

In conclusion, I would like to state that several patients have confided in me that they felt quite aged after X-ray treatment.

DR. JOSEPH L. BAER: In this connection, I would mention a case of polyp at the internal os, with the presence of multiple fibroids, in which laparotomy disclosed a right extra-uterine preg-

[1] Dr. Stein. Med. Recorder, 1916.

nancy. This is an illustration of what has been pointed out, i.e., the folly of employing the X-ray.

DR. A. H. CURTIS: We have discontinued the use of the X-ray for these purposes and are employing radium.

DR. N. SPROAT HEANEY: A surgical procedure I consider the first choice in the treatment of fibroids of the uterus. I do not think that every fibroid of the uterus needs treatment and believe that only those producing symptoms should be treated. In the event that an operation is contra-indicated, I favor the application of radium since it can be placed at the seat of the difficulty without the danger accompanying the X-ray. The contra-indications for operative treatment, however, occur so seldom that necessity for another treatment rarely arises. I am, however, opposed to routine treatment of fibroids by any other method than by the operative procedure.

DR. CHANNING W. BARRETT: Surgery had solved the fibroid question before radiotherapy came into use. Once, many things were employed to keep the fibroids from growing: waiting for the menopause, or producing an artificial menopause by the removal of healthy ovaries, so that the diseased structure might remain and cause trouble. When hysterectomy came into vogue, the diseased structure was removed and the healthy structures, such as the uterus and ovaries were left. After all this problem has been settled, some one now proposes again to deal with the diseased fibroid by bringing about the menopause. We do not think that it is rational to deal with a fibroid uterus by destroying the function of the ovaries. The usefulness of the ovaries should be preserved. The use of the X-ray should be limited to stopping hæmorrhage from fibroids in a patient who is not in a condition for operation. Even in such cases the rays should be cautiously employed, because their use obliterates lines of demarcation and renders the subsequent removal more difficult. The X-ray has very little use in a uterine fibroid condition.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 2, 1917, WITH DR. WILLIAM FULLER IN THE CHAIR

COLLOID GOITER

DR. PAUL F. MORF: I have a specimen of goiter I wish to show which I removed some months ago. There is nothing of particular interest about the pathology of the goiter, but the specimen is of interest because of its unusual size. I will not take the time to present the history of the case. The patient had a very large colloid goiter and it was removed under local anæsthesia. The patient said she had no pain whatever. She left the hospital at her own request on the fifth day. Later a little infection developed in the wound and she came back, but otherwise had an uneventful recovery. Considering its size, one might think it would be difficult to remove under local anæsthesia, but there was no difficulty whatever. I removed a goiter, some time after, which went down behind the clavicle practically to the arch of the aorta. It presented far greater difficulties in removal than this one, despite the fact that it was not of large size.

1. PYLORIC OBSTRUCTION DUE TO THE INGESTION OF STRONG SULPHURIC ACID; GASTRO-ENTEROSTOMY; RECOVERY

DR. ALBERT E. HALSTEAD: I will show the roentgenograms and report the case of a young man who suffered from a pyloric obstruction due to the ingestion of a considerable quantity (probably about four ounces) of commercial sulphuric acid. This accident occurred on November 27. He entered the St. Luke's Hospital immediately and was given the routine treatment with usual antidotes for sulphuric acid poisoning. His condition was precarious for two days but he gradually improved and was taken home in a fairly good condition on the tenth day after the acid was taken. At the time, he was permitted to take liquid nourishment. He vomited occasionally, but most of the liquids taken were retained. Two weeks after returning home he had a severe gastric hæmorrhage, vomiting about 10 ounces of blood. The day following he had a second hæmorrhage of about the same quantity. Two days later he vomited about four ounces of pus. This was repeated on the day following.

Since about December 20, there has been no evidence that any of the food taken has passed the pylorus. He vomited daily all of the liquids taken, at times with a considerable quantity of pus.

Fluoroscopic examination after the ingestion of a bismuth meal proved conclusively that nothing passed the pylorus. The roentgenogram taken at this stage of the disease shows, as you can see, that the stomach is represented by a shadow, showing a blind pouch high up, corresponding to the cardiac end and the fundus of the normal organ.

The patient was operated upon on January 2. The stomach was found constricted below the fundus, the constricting band passing from the lesser to the greater curvature and involving both

the anterior and posterior walls. The portion below this constriction was devoid of lumen, and was represented by a hard, fibrous mass which terminated at the pyloric ring. The lesser peritoneal cavity was explored and found to be obliterated by the inflammatory process which had destroyed the stomach. There was no chance offered to attach the intestine to the posterior wall, so an anterior retrocolic gastro-enterostomy was performed, the gut being attached high up close to the cardiac end.

The patient made a rapid recovery. Liquids were given in increasing quantity after 12 hours. At the end of a week he was ready to leave the hospital, having gained 5 pounds in 5 days.

I will now show you the roentgenogram taken one week after the operation. You can see that the bismuth is passing freely into the small intestine through the gastro-enterostomy opening.

There are not many cases reported of pyloric obstruction from ingestion of caustic poisons.

In 1902 in the *Revue de Chirurgie*, Quénu and Petit reported a case of hydrochloric acid poisoning in which after eight years a gastro-enterostomy became necessary. They reviewed the literature of this subject and found 33 cases besides their own in which obstruction of the pylorus had resulted from corrosive poisons. Three of these were from sulphuric acid. In one operated on by von Eiselsberg the patient had two strictures of the œsophagus, along with obstruction of the pylorus. In three other cases it was necessary to treat strictures of the œsophagus which were present with the obstruction of the pylorus. In all the others, no permanent lesions of the œsophagus were mentioned. The pyloric lesions were treated by pyloroplasty in all but seven cases. These were treated by gastro-enterostomy, with five recoveries and two deaths.

In my case there appears to be no lesion of the œsophagus. His lips and mouth were burned but not deeply.

2. BENIGN BONE CYST; PATHOLOGIC FRACTURE OF UPPER END OF HUMERUS; INTRAMEDULLARY BONE GRAFT

DR. HALSTEAD: This young man, H. B., is 24 years of age. In September, 1915, he sustained a fracture of the upper end of the shaft of the right humerus, two inches below the head. The trauma causing the fracture was insignificant; in going downstairs he was pushed against the balustrade without any considerable force and the bone was broken.

He was admitted to my service immediately after the accident. The X-ray of the fracture revealed a benign cyst of the bone at the seat of fracture. He gave a history of having been treated one year before for a fracture of the same bone at the same location. This fracture had been reduced and union was complete in about six weeks.

Owing to the fact that there was present a bone cyst of considerable size causing unusual fragility of the bone, an open operation was done. The cyst cavity, which was the size of an English walnut, was thoroughly curetted; the medullary cavity of the shaft below and above the fracture was scraped with a sharp curette. A bone graft four and one-half inches long was removed from the crest of the tibia and, after shapening it to fit the medullary canal of the shaft, it was driven just into the shaft below the fracture and then the upper fragment was forced down over the upper part of the graft. The graft fitted so snugly that after its insertion the arm could be handled as if no fracture had been present.

I will show you roentgenograms taken from time to time since the operation. These show clearly that the fracture is healed and that the cavity of the bone cyst is obliterated. They also show that there has been a gradual absorption of the bone graft, which is indicated by the eroded appearance of the surface of the graft and by the less distinct outline. The last one taken yesterday shows only a faint outline of the graft which has materially lessened in diameter since it was introduced.

3. RESECTION OF THE UPPER HALF OF THE HUMERUS FOR SARCOMA (MEDULLARY) OF THE UPPER END; BONE TRANSPLANT

DR. HALSTEAD: This young woman, T. N., entered my service at the St. Luke's Hospital in July, 1913. One year previously she was kicked by a horse and received a bruise of the right arm near the shoulder-joint. Shortly afterward, she began to experience pain. The arm became swollen, and the pain and disability increased. Examination on July 9, the day of entrance in the hospital, showed a spindle-shaped enlargement of the upper end of the humerus. The arm was painful; movement of the shoulder in any direction was impossible. A roentgenogram of the shoulder and humerus showed a medullary growth involving about 4 inches of the upper extremity of the humerus.

Operation July 14, 1913. The humerus was exposed from the shoulder-joint down to a point just below the middle of the bone; a trifle less than one-half of the bone, including the upper extremity, the ligaments of the shoulder-joint, and the articular surface of the glenoid cavity, were removed.

A graft exceeding in length by one and a half inches the part resected was removed from the tibia. The graft was triangular in outline, and was covered on two sides by periosteum. On one side it contained medullary tissue. One end was shaped so that it could be driven into the medullary canal of the remaining portion of the humerus for a distance of one and a half inches. The periosteum of the lower extremity of the graft having been pushed back, was united to the periosteum of the lower end of the shaft of the humerus by catgut sutures. The upper end of the graft was rounded so as to form an articulating surface. This was

covered with fascia taken from the anterior chest wall near the shoulder. The posterior muscles as well as the pectoralis major were attached to the graft. The wound was closed and healed by primary union. The shoulder and arm were retained in a plaster cast for six weeks. After that, passive and active movements were carried on until she left the hospital about the middle of September. Since leaving the hospital she had used the arm in her work without any pain or discomfort. The shoulder movements are about normal except abduction which is limited. She is able to abduct the arm only to a right angle as you can see.

DISCUSSION

DR. D. B. PHEMISTER: I believe that as time goes on the intramedullary graft will be gradually absorbed as the cortical portion of the bone becomes stronger and the cystic condition heals. It is a matter of the internal architecture being reconstructed. After the cortex hypertrophies and is sufficiently strong to support the shaft, there is no reason for the continued existence of the intramedullary graft. It is a matter of functional adaptation. Nature makes every endeavor to restore conditions as they were, not before the operation, but before the disease set in. Take that last case, the transformation of the transplant into a structure which resembles the upper end of the humerus. You can see that is growing.

I recently had an opportunity to examine a transplant which consisted of the crest of the tibia which I inserted into the lower end of the ulna where I had removed a sarcoma. It was much smaller, probably one-third the size of the transplant which Dr. Halstead used in this last case. Eight months after inserting the graft there was a small recurrence in the radius. I excised the recurrence, a portion of the transplant, and the end of the shaft because there was non-union. I had a chance to study the transplant, and it was remarkable to see the way in which it was transformed into bone with the medullary cavity. The piece of bone I put in consisted of the crest of the tibia. There was a definite medullary cavity and cortex in it and it was a circular line. I think the same thing is going on in Dr. Halstead's case, but it will take much longer to grow because of the size of the transplant and the size of the bone that will have to be formed to replace it.

DR. VICTOR L. SCHRAGER: I would like to know the technique used in attaching the upper end of the transplant to the cavity, whether there was any attachment or not and whether it was held in position by the muscles.

DR. HALSTEAD: I wrapped the posterior muscles around the bone graft and attached it by a catgut suture to the periosteum.

An interesting feature of the graft Dr. Phemister spoke about is that it is gradually growing less distinct. The difference between that graft and the one in the girl is quite apparent. The one in the young woman is just as large as it ever was and it is rounded off in the shape of the humerus. It shows no tendency to disappear whatever. The function of the arm and movement of the arm require that it be kept there. The other graft is no longer required. As soon as the bone heals, that probably will disappear.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD JANUARY 4, 1918, WITH THE PRESIDENT, DR. CARL BECK, IN THE CHAIR

SUTURELESS SKIN-SLIDING METHOD FOR THE RADICAL TREATMENT OF LUNG ABSCESS AND CHRONIC OSTEOMYELITIS

DR. EMIL G. BECK read a paper entitled "Sutureless Skin-Sliding Method for the Radical Treatment of Lung Abscess and Chronic Osteomyelitis." (See p. 259.)

DISCUSSION

DR. E. WYLLYS ANDREWS: Dr. Beck has given us a very interesting and instructive presentation on this subject, and one might think from seeing the pictures that this was only a mechanical problem in the sliding flap method. Perhaps there is nothing gained by turning points of skin flaps inward over leaving a bridge of skin; but apparently we are dealing here with a principle of surgery which we see illustrated in all kinds of skin grafting; namely, if one can approximate epithelial surfaces to growing or living surfaces, the stimulating or regenerative action from the margins of the epithelial surface actively go on and proliferate and close over areas more quickly. We see in one method, old-fashioned reverdin grafts scattered like islands over the surface, and from the presence of this implanted epithelium rapid stimulation and epithelization. That seems to be the secret of Dr. Beck's success; otherwise one might say we cannot gain anything in point of time or in the quality of healing by merely sewing points of flaps in, because the skin can be made to sink in and the cavity collapse as completely by the older Erstlaender or Schede operations.

DR. JAMES M. NEFF: I would like to ask Dr. Beck what he does with the areas left after taking

these large flaps, whether he skin grafts or not; how these surfaces contract and how rapidly.

DR. DANIEL N. EISENDRATH: There is one point I would like to emphasize in connection with the X-ray, and that is that the stereoscopic X-ray has superseded practically every method of diagnosis.

I want to show some lantern slides illustrating points in the differential diagnosis of some of these thoracic lesions.

This slide illustrates beautifully the difference in density of the shadow between a serous effusion and a bloody effusion. Oftentimes it is necessary, especially after an injury, to say whether we are dealing with a serous effusion or a bloody effusion. In the lung it does not make much difference. Unless pressure upon the heart supervenes, the thorax will take care of itself.

The next slide shows the lesser density of a serous effusion and a transverse line of dullness. The heart is not displaced at all, and the lung appears compressed.

The next picture, which was taken with the patient in a horizontal position, shows that the fluid is movable which confirms the diagnosis of a nonencapsulated fluid as distinguished from an encapsulated empyema. The surface of the fluid is at right angles to the diaphragm instead of being parallel to the diaphragm.

The next picture shows a difference in density of the blood because the shadow is absolutely opaque. This was a stab wound of the abdomen with an extensive contusion of the thorax, with an enormous hæmothorax on the left side, which displaced the heart to the right and had to be aspirated to save life.

The next is a picture of an abscess in the posterior half of the lower lobe of the left lung and in the posterior half of the upper lobe of the left lung. It shows a circumscribed shadow distinct from an empyema or even a serous effusion. On the left side there was a lung abscess following tonsillectomy, which finally yielded to the injection of bismuth paste after resection of the ribs had proven of no avail.

This next picture is a beautiful example of a shadow which might be taken for an abscess of the lung. An abscess of the lung seldom will, if ever, give rise to such a dense shadow. This was an endothelioma of the pleura, a circumscribed mass due to this tumor.

I want especially to recommend something which Dr. Beck did not emphasize and that is the value of the surgeon himself going into the X-ray room and studying shadows himself under the fluoroscope, watching the movements of the diaphragm and noting the influence which changes in position will have upon the fluid in the chest. The X-ray in my experience has superseded for our surgical purpose every other method of diagnosis.

DR. CARL BECK: In the first case that you saw my brother pointed out that gradually the tissues pushed the flap out and slowly obliterated the cavity, so that the skin flap came more to the surface. You noticed that in most of the pictures. There is an important lesson in this when we study recent war pictures.

I have been much interested in plastic work and in studying pictures of cases; without intentionally doing the same thing, surgeons have had to promote this healing with skin flaps. Wounds of the face in this war are very ragged. The skin forms flaps by the injury, and these flaps turn inward as the wound which is treated is an open wound at first. As all surgeons know the open wound treatment, whether you irrigate or not, is the best treatment. This treatment opens all recesses of the wound and allows the discharge of secretions. Gradually the flaps turn inward and the result is a disfigurement of the face. That is the picture which comes to the plastic surgeon afterwards. These scars of the flaps healing to the bone remain unsightly if not subjected to a plastic operation. When these war wounds have held retracted skin flaps toward the bone and formed these irregular deep scars in the face, which often show deep retractions clear down to the upper jaw, the plastic surgeon has to retrace the steps of wound healing; he has to resect every vestige of the scar, and if there is no infection, to bring together the healthy surfaces and healthy muscles and healthy fascia, and after he has united all he brings together the borders of the epidermis over this elevated portion, making a good plastic effect and obliterating all the defects and scars. That is what I call scar elimination. The same thing has been reported by others who have worked along this line, resecting the scars gradually bringing the normal tissues in their normal position. Thus we obliterate cavities, and bring the skin together, so that the deeply retracted scars of the cheeks fill out. If there is bone, fat, or cartilage missing, it has to be transplanted and implanted, and we get plastic results which obliterate these defective scars.

DR. EMIL G. BECK (closing): We use adhesive plaster strips which adhere like a postage stamp along the border covering the junction of the skin and the granulating surface. This gives a sort of leading surface along which epithelial cells grow. It is remarkable with what rapidity skin grows from the sides, often covering surfaces as large as my hand. After removal of a breast I left a surface as large as my hand denuded and it gradually healed over with normal skin.

The adhesive plaster method I learned from the dressing of wounds of burns. One of our ex-internes treated a great many electric burns in that way. I watched his cases and saw surfaces ten inches long and four inches wide epidermized by that method, and so I adopted it for this new purpose.

In reply to Dr. Neff, I do not decry skin grafting because I know some excellent results have been obtained from it, and I occasionally resort to it.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

TO say more of a new edition of the *Obstetrics* by Williams [1] than that has appeared in print, would seem like carrying coal to Newcastle. Everyone knows that this is a classic in obstetrics and that it is one of the most worth-while books American literature may boast of. The fourth edition has been thoroughly revised and the advances made in obstetrics in the past five years, have rendered a slight increase in size unavoidable. The main textual changes cover the following subjects: anatomical changes during menstruation; placentation; metabolism of pregnancy and puerperium; Abderhalden's pregnancy reaction; changes in the endocrine glands; obstetrical anæsthesia; cæsarean section; the relation of syphilis to the generative process; etiology and treatment of abortion and premature labor; the use of pituitrin; transverse presentation; and premature separation of the placenta.

One of the reviewer's friends makes it his custom to read "his Williams" from cover to cover one a year. If this excellent habit were emulated by many practitioners, the standards of obstetrical practice in this country would rise at once and become the model for other nations.

IT is one thing to read, with pleasure and profit, the three imposing tomes which constitute *The New System of Gynæcology* by Eden and Lockyer,[2] and quite another to write, in the few columns allotted to book reviews, a synopsis which would do adequate justice to this pretentious work. There is, however, little need to go into such detail, for the gynecologists of this or any other English speaking country will be only too eager to add these volumes to their libraries and to enjoy for themselves this remarkable collection of monographs. Eden and Lockyer who have quite recently brought out an excellent textbook on gynecology for students and practitioners have, despite the troubled times, succeeded in assembling 57 of the ablest gynecologists of Great Britain, the United States, and Canada. The names of many of the contributors are familiar to us and carry with them a guarantee of substantial scientific food. And there are numerous others, younger ones, who as they reveal themselves in these pages, promise a hopeful outlook for the future of our specialty. Of our own countrymen, we greet our friends Howard C. Taylor, of New York, and Franklin H. Martin, of Chicago.

The general plan of the work can be best stated in the following paragraph taken from the preface. "Gynecology has become definitely a special branch of surgery, in close touch with abdominal surgery generally, and the old view that the gynecologist is a physician not a surgeon is no longer tenable. In consequence of this development the interests of the gynecologist have necessarily broadened. Pelvic disease in women is frequently associated in the relation of cause or of effect, with diseases of the gastro-intestinal and urinary canals; the gynecologist has accordingly realized that he must be prepared to deal with whatever condition he may find on opening the abdomen for the relief of disease apparently of pelvic origin. And further, he must be familiar with the special methods which are employed in the investigation of such diseases, as those of the kidneys, the bladder, and the rectum. Diseases of the female breast fall so obviously into the province of the gynecologist that no explanation of the inclusion of this subject is called for. The vermiform appendix possesses relationships of unique intimacy with the pelvic organs, and there is no doubt that cases of appendicitis in women very frequently come under the care of the gynecologist. During pelvic operations, injuries to the intestines necessitating enterorrhaphy or enterectomy frequently occur, with which it is quite obvious that he must be prepared to deal. And further, during convalescence from abdominal operations, intestinal complications may arise which call for a sound knowledge of intestinal surgery."

Volume I deals with gynecology in general and contains articles on anatomy, physiology, methods of examination, disorders of function, malformations, and the various types of infection (septic, gonorrhœal, tubercular, syphilitic), etc. Volume II treats of the affections of the various reproductive organs, and Volume III is devoted to gynecologic therapy, operative and otherwise.

Nor is the *hinterland* of gynecology neglected, and we find in these volumes articles on nervous disorders associated with morbid conditions of the

[1] Obstetrics; a Textbook for the use of students and practitioners. By J. Whitridge Williams, M.D. 4th ed. New York and London: D. Appleton & Co., 1917.

[2] The New System of Gynæcology. Edited by Thomas Watts Eden, M.D., F.R.C.S., F.R.C.P., and Cuthbert Lockyer, M.D., B.S., F.R.C.S., F.R.C.P. 3 vols. London and New York: The Macmillan Company, 1917.

pelvic organs in women, on diseases of the breast, the appendix and rectum, on hernia and bladder, and on intestinal complications in gynecologic surgery.

How bare this brief summary appears in comparison with the wealth of material offered to us! Some of these articles are real gems. Take for instance Chipman's chapter on backward displacements of the uterus and enjoy to the fullest the virile style, the lucidity of thought, the skill of exposition even though you may miss here and there a point in symptomatology, diagnosis, or therapy which seems of importance to you. In so large a collection of monographs not all contributions can reasonably be expected to be of equal value, yet, by far the greatest number deserve unstinted praise.

The work does not consider in detail the entire literature of the world and thus is not as encyclopædic as its older competitor, Veit's *Handbuch der Gynaekologie*, but there is no lack of thoroughness and there is a personal tone in it which is immensely attractive. It is as if you were comparing notes with another gynecologist whose views you may not share in every particular, yet whose opinions you always hold in high respect. For this is a work not written for the student or novice in gynecologic practice, but for the man who has already won his spurs and therefore has learned to read critically and appreciates even more the opportunity to commune and to debate with a number of his fellows. It seems an ideal way to get into close touch with practically the entire gynecologic profession of two countries. The energy and wide vision of the editors and the munificence of the publishers in the way of beautiful and abundant illustrations and attractive make-up deserve the warmest commendation.

THE second edition of De Normandie's book[1] has appeared in a surprisingly short time. The words of warm recommendation with which we greeted the first edition[2] are equally applicable today. These "case histories" represent the methods of bedside teaching in book form. The work is divided into twenty-eight sections. Each section deals with one of the normal or abnormal conditions which the obstetrician encounters in his work. A few of the headings may serve as illustrations: Miscarriage; normal pregnancy; prolapsed cord; contracted pelvis; nausea and vomiting of pregnancy; face presentation; pyelitis; mastitis; heart disease in pregnancy. Several chapters are devoted to technique of, and indications for, certain therapeutic measures, such as forceps, version, scopolamine and morphine anæsthesia. Each section, that is each subject, is composed of one or more case reports taken from actual and personal practice, and a summary in which the author introduces important points in diagnosis, prognosis, and therapy.

A wise pedagogue once remarked: "The best teacher is he who does not seem to teach." This applies exceedingly well to the book before us. It is written in the lightest conversational style. One can imagine the author, not in a class room teaching the principles of obstetrics, but at the bedside recounting to a group of students the experinece he has had with this particular patient, or reporting, among a few fellow practitioners, the interesting features of a special case. And in the form they are presented to us, all these cases are interesting, from a normal left occipito-anterior delivery to a premature separation of the placenta or an incomplete rupture of the uterus.

The work does not aim to usurp the place of a textbook on obstetrics, but it supplements the functions of the latter in a most felicitous manner. To the student it serves as a repertory of what he has learned in lecture room and clinic, and to the man in active practice it may often take the place of a consultant when such a one is not available. In any case it will stimulate the reader to attain a higher standard in his obstetric work.

IF you have heretofore associated in your minds the term "Handbook" with an extensive work of one or more bulky tomes, the most recent handbook of gynecology[3] will quickly undeceive you. In a slender volume of a little more than 400 pages, the authors have understood how to condense all that the third and fourth year medical students as well as the young practitioner should and must know of the essentials of gynecology. To accomplish their object within a limited space, the authors have exercised a wise and most commendable restraint. They have realized that as far as the medical student is concerned, gynecology ranks in importance after medicine, surgery, and obstetrics, and in consequence they have omitted all mooted questions, theoretical considerations, and long descriptions of major operations and their technique. Their desire to be brief has, however, not led them to a dry compendial enumeration. There is, on the contrary, a consistent effort noticeable to keep in view the prime importance of interpreting morbid objective data and to trace the relationship between pathologic cause and physical effect. In this connection, the chapter on gonorrhœa may be mentioned as particularly praiseworthy. The original illustrations are quite instructive; those adopted from other sources are well selected.

That a book of the character indicated is dogmatical in its expressions, is perfectly natural. We would earnestly wish that all medical students might absorb the teachings presented by Lewis and de Roulet. There is very little one might possibly object to. The unreserved recommendation of

[1] CASE HISTORIES IN OBSTETRICS. By Robert L. De Normandie, A.B., M.D., F.A.C.S. 2d ed. Boston: W. M. Leonard, 1917.

[2] Surg., Gynec. & Obst., 1915, xx, 500.

[3] HANDBOOK OF GYNECOLOGY; FOR STUDENTS AND PRACTITIONERS. By Henry Foster Lewis, A.B., M.D., and Alfred de Roulet, B.Sc., M.S., M.D. St. Louis: C. V. Mosby Company, 1917.

nitrous oxide anæsthesia may be cited as an example. Is it really true that this form of anæsthesia has thus far caused only one solitary death? In describing in detail and illustrating the operations for vesicovaginal fistula and of supravaginal amputation of the uterus, the authors have not been quite consistent; we would have preferred to see the operation of curettage more fully illustrated and more thoroughly described.

But such imperfections are too insignificant to detract from the value of the book. It seems to us that in addition to students and young practitioners, many gynecological teachers will be glad to avail themselves of its advantages as a basis of their lectures.

IT seems hardly necessary to explain why a book on veterinary obstetrics [1] should be reviewed in these columns which are devoted to works on human pathology. The embryologist, the physiologist, the teacher of obstetrics, the research worker will quickly vouch for the legitimacy of such procedure. By far the greater part of our knowledge of the science of human obstetrics is based upon observations of animals, and there are yet many important problems waiting their solution through animal experimentation. The relationship between ovulation and menstruation which has caused so much confusion and controversy, has only recently been cleared up by Fraenkel through studies upon animals. The remarkable observations by Leo Loeb of parthenogenetical processes in the ovaries of guinea pigs with their bearing upon the formation of teratomata calls for investigations on other and larger animals. The corpus luteum question and its direct application to the human is intimately connected with veterinary obstetrics, and the list of points of contact between the sciences of human and veterinary obstetrics can easily be extended. There has been until now a need for a truly scientific book on veterinary obstetrics, and we are indebted to the author for presenting to us his work which will prove of great value to the men engaged in comparative studies. The clinician, too, will find much that is of interest, and he cannot but be impressed by the abundance of material adduced.

[1] VETERINARY OBSTETRICS. By William L. Williams, Professor of Obstetrics and Research, Professor in Diseases of Breeding Cattle, New York State Veterinary College, Cornell University, Ithaca, N. Y., 1917.

THE rapid strides in laboratory methods make it imperative for the progressive physician to keep abreast of the advances made. A textbook on this subject should not only indicate the proper technique of the methods of laboratory diagnosis, but should also emphasize the relative value of the procedures and the practical importance of the knowledge so obtained. This object has been eminently well achieved by Wood in his *Chemical and Microscopical Diagnosis*.[2] "The facts obtained in the laboratory," says the author, "may occasionally be of more value than those secured by the physical examination of the patient; they more often possess a corroborative force ranking with the observations procured by the stethoscope and eye; occasionally they have merely a scientific worth and are relatively unimportant from a point of view of an immediate diagnosis."

The experience of the distinguished writer in hospital work and teaching of clinical pathology has enabled him to present to students, hospital interns, and practitioners, in an authoritative way, the microscopical and chemical examination of the blood and the secretions and excretions of the body. In the third edition which has recently appeared, several additions and alterations have been made, notably the technique of the Wassermann reaction and the preparation of vaccines, the antiformin method of concentrating tubercle bacilli in sputum, functional tests of the activity of the gastro-intestinal tract, and hæmolytic tests.

A work of such intrinsic value hardly requires commendation — it recommends itself.

[2] CHEMICAL AND MICROSCOPICAL DIAGNOSIS. By Francis Carter Wood, M.D. 3d ed. New York and London: D. Appleton & Co., 1917.